Helsinki Studies in Education, number 63

Päivi Virtanen

Self-Regulated Learning in Higher Education

Basic Dimensions, Individual Differences, and Relationship with Academic Achievement

Doctoral dissertation, to be presented for public discussion with the permission of the Faculty of Educational Sciences of the University of Helsinki in Room 302 at Athena, Siltavuorenpenger 3A, on Wednesday 18th of December, 2019 at 12 o'clock.

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Abstract
The purpose of this doctoral thesis was to explore the basic dimensions of self-regulated learning (SRL) in higher education (HE) and to discover how students differ in SRL. The differences in SRL were examined on terms of SRL profiles and between discipline and gender groups. In addition, the relationship between self-regulated learning and academic achievement was investigated. It was examined how SRL measured in the first study years predicted later learning outcomes of students in terms of cumulative GPA and study progress. Secondly, academic achievement was explored by finding out how SRL is related to active learning and achievement of professional competencies in teacher education. For this doctoral thesis Paul Pintrich's (2000a) General Model of SRL was used as a theoretical framework.

This thesis is based on three original published studies. The IQ Learn online instrument measuring multidimensional SRL in HE was used for data collection concerning SRL in the original studies. Same data (N = 1248) were used to explore SRL differences in Study I and SRL profiles and interrelation between SRL and academic achievement in Study II. Study III examined how student teachers (N = 422) with different SRL profiles benefited from active learning to achieve professional competencies. Statistical research methods were used for the data analysis in this doctoral thesis. In addition to the three original studies, second-order analyses were conducted and reported in the summary of this thesis.

The analyses within the Studies II and III and the second-order factor analyses showed consistent features in HE students' SRL, which was composed of three basic components such as Resource management strategies, Advanced learning strategies, and Self-efficacy beliefs. Even though, HE students' SRL was found to include also other important motivational and regulation components, and cognitive learning strategies.

In Studies II and III, a total of five different SRL profiles were identified. The students with a profile Excellent in SRL had high self-efficacy, were persistent and used often management strategies and versatile advanced cognitive learning strategies. Also the students with the profiles Aiming high with insufficient SRL and Dissonant SRL had high self-efficacy, but they were less persistent and used

less management, self-evaluation, and cognitive learning strategies. The students with the Distressed performers profile and the Moderate SRL profile had moderate self-efficacy and used more seldom the management strategies than the other students. Students with the two latter profiles rarely reflected upon their learning in order to improve their study strategies or self-evaluate their learning results. Study II showed statistically significant differences in SRL between HE students from different disciplines and genders. The students of Behavioural Sciences tend to score higher on SRL components and the students from Technology and Science in most cases scored lower than students from other disciplines.

SRL measured in the first study year did not predict study success of later HE studies. However, the results showed that when student teachers' experiences of active learning in teacher education increased, they achieved better professional competencies. Student teachers with Excellent SRL profile profited substantially from active learning methods' use and achieved the best professional competencies. Similarly, student teachers with Moderate SRL profile also achieved statistically significantly better professional competencies when their active learning experiences increased. Meanwhile students with the Dissonant SRL profile benefited less from active learning. Active learning experiences had the strongest positive effect on all students' competency Teachers' own professional learning including researching of own work, critical assessment of teacher education, SRL, cooperative action research and interest in post-graduate studies of education. The results of this doctoral thesis can be used for development of student guidance and curriculums in HE.

Keywords: self-regulated learning (SRL), SRL profiles, higher education (HE), academic achievement, active learning, professional competencies

Helsingin yliopisto, Kasvatustieteellinen tiedekunta
Kasvatustieteellisiä tutkimuksia 63

Päivi Virtanen

Oppimisen itsesäätely korkea-asteen opinnoissa
Perusulottuvuudet, yksilölliset erot ja yhteys oppimistuloksiin

Tiivistelmä
Tämä väitöstutkimus tarkasteli korkea-asteen koulutuksen kontekstissa oppimisen itsesäätelyn (SRL) perusulottuvuuksia ja opiskelijoiden eroja niissä. Oppimisen itsesäätelyn eroja tarkasteltiin SRL-profiilien sekä tieteenalakohtaisten ja sukupuoliryhmien suhteen. Lisäksi tutkittiin oppimisen itsesäätelyn ja oppimistulosten välistä yhteyttä: miten ensimmäisenä opiskeluvuotena mitattu SRL ennustaa myöhempien oppimistulosten keskiarvoa ja opintojen etenemistä. Yhteyttä tarkasteltiin myös tutkimalla SRL:n ja professionaalisten kompetenssien saavuttamisen välistä yhteyttä opettajankoulutuksessa. Tämän väitöstutkimus pohjautuu teoreettisesti Paul Pintrich:n (2000a) Oppimisen itsesäätelyn malliin.

Tämä väitöstutkimus muodostuu kolmesta julkaistusta osatutkimuksesta ja yhteenvedosta. Osatutkimusten SRL:n liittyvä tutkimusaineisto kerättiin verkkoperustaisella IQ Learn itsearviointivälineellä, joka on kehitetty mittaamaan korkea-asteen opiskelijoiden monidimensionaalista oppimisen itsesäätelyä. Samaa 1248 opiskelijan parissa koottua aineistoa käytettiin tutkittaessa itsesäädellyn oppimisen eroja osatutkimuksessa I ja SRL-profiileja sekä SRL:n yhteyttä oppimistuloksiin tutkimuksessa II. Osatutkimuksessa III selvitettiin miten erilaisen SRL-profiilin omaavat opettajaopiskelijat (N = 422) hyötyivät aktiivisesta oppimisesta professionaalisten kompetenssien saavuttamisessa. Tutkimusaineistoja analysoitiin tilastollisilla menetelmillä. Väitöskirjan yhteenvetoa varten kolmen alkuperäisen osatutkimuksen lisäksi tehtiin osatutkimusten aineistolla toisen asteen analyyseja.

Osatutkimusten II ja III ja toisen asteen faktorianalyysien tulosten mukaan korkea-asteen opiskelijoiden oppimisen itsesäätelyssä on pysyviä ominaisuuksia, jotka sisältävät kolme perusulottuvuutta: resurssien hallintastrategioita, edistyneitä opiskelustrategioita ja pystyvyysuskomuksen. Näiden ulottuvuuksien lisäksi korkea-asteen opiskelijoiden oppimisen itsesäätelystä löytyi myös muita tärkeitä komponentteja liittyen motivaatioon, oppimisen säätelyyn ja kognitiivisiin oppimisstrategioihin.

Tutkimuksissa II ja III tunnistettiin viisi erilaista SRL-profiilia. Opiskelijat, joilla tunnistettiin Erinomainen SRL-profiili, tunnusomaisesti uskoivat vahvasti omaan pystyvyyteensä, olivat sinnikkäitä ja käyttivät usein hallintastrategioita ja monipuolisesti edistyneitä kognitiivisia opiskelustrategioita. Myös profiilit Kor-

keat tavoitteet, riittämätön SRL tai Epäjohdonmukainen SRL omaavilla opiskelijoilla oli korkea pystyvyysuskomus, mutta he eivät olleet yhtä sinnikkäitä ja käyttivät harvemmin hallintastrategioita, itsearviointia ja kognitiivisia opiskelustrategioita. Ahdistunut suorittaja tai Keskinkertainen SRL -profiilien opiskelijoille oli tyypillistä keskinkertainen pystyvyysuskomus ja he käyttivät muita harvemmin hallintastrategioita. Lisäksi he reflektoivat harvoin oppimistaan liittyen opiskelustrategioiden kehittämiseen tai oppimisen arvioimiseen. Tutkimuksessa I havaittiin tilastollisesti merkitseviä eroja oppimisen itsesäätelyssä eri opintoalojen ja sukupuolten välillä. Käyttäytymistieteen opiskelijat säätelivät keskimäärin vahvemmin oppimistaan ja tekniikan ja luonnontieteiden opiskelijat säätelivät oppimistaan vähemmän kuin muiden tieteenalojen opiskelijat.

Ensimmäisenä opintovuotena mitattu SRL ei ennustanut menestymistä myöhemmissä korkea-asteen opinnoissa. Tämän väitöstutkimuksen tulokset osoittivat kuitenkin, että opettajaksi opiskelevien aktiivisen oppimisen kokemusten lisääntyminen paransi heidän professionaalisten kompetenssien saavuttamistaan. Sellaiset opettajaopiskelijat, joilla oli erinomainen SRL-profiili, hyötyivät merkittävästi aktiivisesta oppimisesta ja saavuttivat parhaat kompetenssit. Myös keskinkertaisen SRL-profiilin omaavat opiskelijat saavuttivat paremmat professionaaliset kompetenssit aktiivisen oppimisen lisäännyttyä. Opettajaopiskelijat, joilla oli epäjohdonmukainen SRL-profiili, hyötyivät vähemmän aktiivisesta oppimisesta. Aktiivisen oppimisen kokemukset vaikuttivat vahvimmin kaikkien opiskelijoiden kehittymiseen kompetenssin Opettajan oma ammatillinen oppiminen osalta, johon sisältyi oman oppimisen tutkiminen, opettajankoulutuksen kriittinen arviointi, oppimisen itsesäätely, yhteistoiminnallinen toimintatutkimus ja kiinnostus kasvatustieteen jatko-opinnoista. Tämän tutkimuksen tuloksia voidaan hyödyntää opiskelijoiden ohjauksen ja korkea-asteen opetussuunnitelmien kehitystyössä.

Avainsanat: oppimisen itsesäätely, oppimisen itsesäätelyn profiilit, korkea-aste, oppimistulokset, aktiivinen oppiminen, professionaaliset kompetenssit

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In Helsinki, November 2019

Päivi Virtanen

Contents

List of figures

List of tables

List of appendices

Original publications

This doctoral thesis is based on the following three original publications, which are referred to in the text by their Roman numerals (Studies I-III):

I Virtanen, P. & Nevgi, A. 2010. Disciplinary and gender differences among higher education students in self-regulated learning strategies. Educational Psychology, 30 (3), 323-347. https://doi.org/10.1080/01443411003606391

II Virtanen, P., Nevgi, A., & Niemi, H. 2013. Self-Regulation in Higher Education: Students' Motivational, Regulational and Learning Strategies, and Their Relationships to Study Success. Studies for the Learning Society, 3 (1-2), 20-36. https://doi.org/10.2478/sls-2013-0004

III Virtanen, P., Niemi, H. M., & Nevgi, A. 2017. Active Learning and Self-Regulation Enhance Student Teachers' Professional Competences. Australian Journal of Teacher Education, 42 (12), 1-20.
http://dx.doi.org/10.14221/ajte.2017v42n12.1

1 Introduction

This study aims to shed more light on one of the central areas in educational psychology: self-regulated learning (SRL). It examines SRL in the context of higher education (HE) and aims to find out how individual HE students differ in SRL and what components of SRL are the most important for successful learning.

SRL plays an important role in HE and has become one of the most-researched areas of educational psychology (Panadero, 2017). The reason for SRL's relevance to successful learning originates from its active and conscious approach towards learning. The conscious-learning approach includes setting one's own goals and comparing learning results to these goals. Pintrich's (2000a) SRL theory, on which this study is based, and other SRL theories (e.g. Zimmerman, 2000a) stress the importance of learners' own goals, which should guide students to monitor, regulate and control their cognition, motivation and behaviour to reach the goals they have set for their learning.

Even though learning in HE, coping with life and navigating the 21st century (Griffin, Care and McGaw, 2012) are more successful with effective self-regulation skills, research shows that not all HE students are able to regulate their own learning (e.g. Azevedo & Cromley, 2004; Barnard-Brak, Lan, & Osland Paton, 2010; Vrugt & Oort, 2008). It can be argued, that SRL is even more important now than ever, as the ways of learning, thinking and working are changing continuously and demanding a lot of autonomy. Learning-to-learn and metacognitive-thinking skills are core skills needed in HE and in the workplace, and these are essential elements of SRL. Kramarski and Michalsky (2009b) and Zimmerman (2000b) evidenced that students' SRL can be enhanced towards autonomous and self-regulated learning through guidance or by environments that provide opportunities to control over one's learning. However, we still need more research on core elements in SRL and how learners differ in their self-regulation.

The idea for this study originate from a research project called IQ Form (Niemi, 2002b). The Ministry of Education launched the Finnish Virtual University (FVU) in 2001 and the IQ Form project (www.edu.helsinki.fi/iqform/default_eng.htm) was one of the projects for the FVU (Niemi, 2002b). In the project, a technology-based, interactive self-evaluation and tutoring system, IQ Learn was created. The main idea of the IQ Learn system was to empower HE students by increasing learners' self-knowledge and to evaluate and develop their self-regulation and learning skills (Niemi, 2002b; Niemi, Nevgi, & Virtanen, 2003; Niemi & Ruohotie, 2002). The self-reporting inventories of the IQ Learn system were used for the data collection in this research. Self-regulated learning has recently been widely discussed in educational psychology worldwide and mentioned in education plans in many countries in Europe and other continents (e.g. Griffin, Care &

McGaw, 2012; NIE, 2009). Therefore, it is important to continue research on SRL to find ways and methods that encourage students' development in self-regulation.

This study was conducted in Finnish HE context, which includes much freedom and flexibility and aims to educate independent academic experts. Although only a small percentage of applicants pass the demanding entrance examinations of universities, students still have varying SRL skills (e.g. Heikkilä & Lonka, 2006). There is a need to understand more deeply how HE students' SRL is structured and how students with different SRL learn most effectively.

1.1 Aims of the doctoral thesis

The purpose of this study is to explore the basic dimensions of self-regulated learning (SRL) in higher education (HE) studies and to discover how HE students differ in SRL. In addition, this doctoral thesis investigates how SRL is related to academic achievement and development of professional competencies. Theoretical background of this doctoral thesis is based on Paul Pintrich's (2000a) theory of SRL and the context of this study is Finnish HE. The focus areas of this research and their connections to the original published studies are presented in Figure 1.

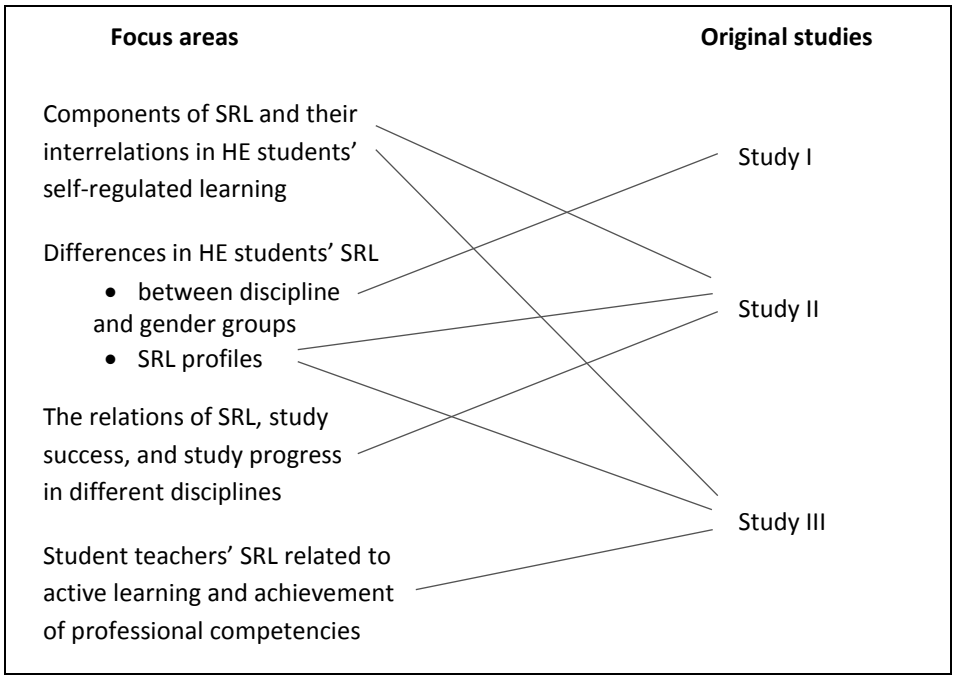


Figure 1. The connections between the focus areas of this study and the original studies.

The first aim of this study focuses on the structure and the most important components of SRL in HE studies. Original studies II and III were analysed for the first study aim: to define the most important components of HE students' SRL. In addition to analysing the original studies' results, second-order factor analysis was conducted to further analyse the components of SRL and identify larger components, which may be important for HE students' learning.

The second aim of this study is concerned with the differences in SRL among HE students. All original studies were used for the second aim of this study: to find out the SRL differences between discipline and gender groups and to investigate what kind of SRL profiles can be identified among higher education students. According to Cassidy (2011), it is important to research SRL also from the viewpoint of students' individual differences and needs. Cassidy argues that self-regulated learning offers a mechanism capable of both representing students' individual differences and implementing changes in educational practice, which reflect the individual needs of students.

The third and fourth aims of this study focus on investigating how SRL and academic achievement are related. The third aim concerns the relationships between academic achievement and SRL among HE students from several disciplines. Students' study success is commonly used to demonstrate how different factors affect learning outcomes. The previous research has shown inconsistent results in correlations between HE students' SRL and study success (e.g. Cazan, 2012; Kosnin, 2007; Phan, 2010; Richardson, Abraham, & Bond, 2012; Sperling, Howard, Staley, & DuBois, 2004). The original study II of this research investigated how SRL measured in the first study years predicts later learning outcomes of HE students in terms of cumulative GPA and study progress.

The fourth aim of this study concerns the relationship between SRL, active learning, and student teachers' achievement of professional competencies; Study III concentrates on this topic. Self-regulated learning and active learning share several common features, (e.g. they both engage students and include them as active participants in the learning process (Prince, 2004)). Previous research evidence shows that active learning has positive effects on HE students' motivation (Lonka & Ketonen, 2012; O'Grady, Mooney, Simmie, & Kennedy, 2013) and improves professional development and professional identity (Aksit, Niemi, & Nevgi, 2016; Kramarski & Michalsky, 2009a; 2009b; Niemi, 2002a; Niemi & Nevgi, 2014; Preston, Harvie, & Wallace, 2014). However, there is no previous research examining how students with different SRL profiles benefit from use of active learning methods. In Finland, teacher education is part of HE, and student teachers' development in SRL is very important because they are expected to support their future pupils' SRL.

2 Theoretical Framework

The following sections give an overview of the theoretical framework of this study. First, Pintrich's model of SRL is introduced, which describes the main components of SRL. Second, the development of SRL research is briefly explained. Third, the concepts related to SRL are described. The Chapters 2.4 – 2.6 present the concepts and research findings concerning the individual differences in SRL, academic achievement, professional competencies and active learning among HE students. Finally, the Chapter 2 ends by presenting the importance of SRL for HE students.

2.1 Pintrich's General Model of SRL

For the original studies, Pintrich's (2000a) General Model of SRL was used as a theoretical framework. It includes an extensive compilation of SRL components and strategies from several areas of regulation within four different phases of a learning process. To construct the general framework, Pintrich (2000a) analysed several SRL models that propose different constructs and conceptualisations and their common assumptions (e.g. Boekaerts & Niemivirta, 2000; Butler & Winne, 1995; Corno, 1993; Pintrich & De Groot, 1990; Pintrich, Wolters, & Baxter, 2000; Pressley, 1986; Schunk, 1994; Schunk & Zimmerman, 1994; Winne, 1995; Zimmerman, 1986, 1989, 1998a, 1998b, 2000a). Pintrich (2000a) claims that these models share four assumptions: 1) Learners are *active* and *constructive* participants in the learning process, constructing their own meanings, goals, and strategies from the information available from the external environment and their own minds. 2) Learners can potentially *monitor, control,* and *regulate* certain aspects of their own cognition, motivation, behaviour, and some features of their environments, but there are constraints that can impede or interfere in these processes. 3) Comparisons are made against *goal, criterion,* or *standard* in order to assess whether the process should continue unchanged or if some type of change is necessary. 4) Self-regulatory activities are *mediators* between personal and contextual characteristics and actual achievement and performance (Pintrich, 2000a).

Based on these assumptions, Pintrich (2000a, p. 453) proposed a working definition of self-regulated learning: "self-regulated learning is an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour, guided and constrained by their goals and the contextual features in the environment." Zimmerman (2000a) agrees that this definition is compatible with most theoretical

perspectives of SRL, sharing common assumptions about its dynamic, contingent, and contextualised features.

Pintrich's framework (2000a) includes multiple SRL components within four phases that can be found in a learning process within HE contexts. The phases are 1) forethought, activation and planning, 2) monitoring, 3) control, and 4) reaction and reflection (See Table 1). However, Pintrich pointed out that not all learning follows the phases of his framework. There are occasions when students learn academic material in more tacit, implicit, or unintentional ways, without self-regulating their learning.

Table 1. Phases and areas of self-regulated learning in Pintrich's SRL framework (modified from Pintrich, 2004, p. 390).

	Areas for Regulation			
Phases	Cognition	Motivation/affect	Behaviour	Context
1. Forethought planning and activation	Target goal setting Prior content knowledge activation Metacognitive knowledge activation	Goal orientation adoption Efficacy judgments Perceptions of task difficulty Task value activation Interest activation	(Time and effort planning) (Planning for self-observations of behaviour)	(Perceptions of task) (Perceptions of context)
2. Monitoring	Metacognitive awareness and monitoring of cognition	Awareness and monitoring of motivation and affect	Awareness and monitoring of effort, time use, need for help Self-observation of behaviour	Monitoring changing task and context conditions
3. Control	Selection and adaptation of cognitive strategies for learning, thinking	Selection and adaptation of strategies for managing motivation and affect	Increase/decrease effort Persist / give up Help-seeking behaviour	Change or renegotiate task Change or leave context
4. Reaction and reflection	Cognitive judgments Attributions	Affective reactions Attributions	Choice behaviour	Evaluation of task Evaluation of context

Pintrich also analysed regulation of learning in four different areas: cognition, motivation/affect, behaviour, and context. Pintrich's model is the only one among the most known and cited SRL models that comprehends the regulation of behaviour (Panadero, 2017). The SRL components according to Pintrich's framework were divided in four regulation areas and in four phases in a learning process; these are presented in Table 1.

Broadbent (2017) claims that Pintrich's model comprises the most comprehensive set of self-regulatory strategies. Pintrich's SRL framework includes SRL strategies in three categories that learners can apply to regulate learning, such as cognitive, metacognitive, and resource management strategies. In the next paragraphs these are described in detail. This study explores the SRL strategies' use in HE. In Table 2, in this study's section Instruments on page 20, compare Pintrich's SRL strategies to the strategies (i.e. SRL components) measured in this study.

2.1.1 Regulation of cognition

According to Pintrich's SRL model, a learner engages herself in various activities and strategies by planning, monitoring, and regulating her thinking (i.e. cognition). Learners set cognitive goals for learning and activate their prior knowledge and their metacognitive knowledge, which includes all knowledge a learner can acquire about procedures and strategies for cognition (e.g. memorising, reasoning, and problem solving, how to perform and use cognitive strategies, and when and why to use these strategies) (Pintrich & McKeachie 2000; Pintrich 2000a; 2004). In order to become aware of their own progress in learning, students need to be able to monitor their own comprehension and learning. Monitoring of cognition is compounded by important activities related to metacognitive awareness, such as judgements of learning (JOL) and feeling of knowing (FOK). Judgments of learning may occur as activities in which learners actively monitor what they understand by asking questions concerning the text they are reading.

Cognitive strategies are related to students' learning or encoding of material and strategies to facilitate retrieval of information. Pintrich (2004) distinguishes four cognitive strategies: rehearsal, elaboration, organisation, and critical thinking (see Table 2, on page 22). Pintrich and McKeachie (2000) argue that each of these cognitive learning strategies has a basic and complex version, depending on the nature of the learning task. Basic rehearsal strategies are best for simple acquisition and activation of information in to working memory. Rehearsal strategies for more complex tasks are common for HE students, for example, taking notes when reading and underlining and highlighting sections that seem important in the text (Pintrich & McKeachie, 2000). Furthermore, use of elaboration strategies such as paraphrasing, summarizing, creating analogies, explaining, and question asking and answering, helps learners integrate and connect new information with prior knowledge.

In this study, use of keywords and advanced organisers, as well as connecting new and previous knowledge (i.e. constructing knowledge), are important strategies of elaboration and are treated as separate strategies (see Table 2, on page 22). Organisational strategy in this study is understood to help the learner select essential information and this strategy is labelled accordingly. Pintrich sees critical

thinking as a learner's ability to apply previous knowledge to new situations in order to solve problems, reach decisions, or make critical evaluations with respect to standards of excellence (Pintrich & McKeachie, 2000; Pintrich, 2004). In this study, the theoretical approach to learning is differentiated as a separate cognitive strategy for learning in HE.

Pintrich includes planning, monitoring, and regulation of learning activities in metacognitive strategies. Planning activities such as setting goals, skimming, and analysing tasks, help learners plan the use of appropriate strategies, process information, and help to activate relevant prior knowledge. Monitoring strategies include tracking of attention and self-testing to ensure comprehension. Metacognitive self-regulation activities include continuous adjustment and fine-tuning of cognition, and they aim at improving performance when a learner checks and corrects behaviour as they proceed in a learning task (Pintrich & McKeachie, 2000). In this study, self-assessment strategy is related to metacognitive monitoring of learning, to secure understanding in a learning task and to reflect on the learning experience.

2.1.2 Regulation of motivation and affect

In Pintrich's theory (2000a), the value components include goal orientation and task value (beliefs about importance, utility, and relevance of a task) (Pintrich, 2004). The expectancy components include self-efficacy and expectations of success. In addition, Pintrich (2004) distinguishes motivational beliefs such as perceptions of task difficulty and personal interest in the task. Finally, there are affect and emotions, which students may control with coping strategies to help deal with fear and anxiety (Pintrich, 2004). In this study, the motivational components include value components (intrinsic interest, task value), expectancy components (self-efficacy, expectation of success), and an affective and emotional component (performance anxiety).

Within goal orientation, the crucial distinction is between intrinsic and extrinsic goal orientation. Intrinsic goal orientation is related to learning or mastery of goals when a student desires to increase competences and values learning for its own sake. In contrast, extrinsic goal orientation applies to students who see the utility value of studies and the benefit they can derive from them later in life. Bandura (2011) argues that efficacy beliefs are the foundation of human agency and in SRL theory, self-efficacy is a key motivational variable. Anxiety and fears are negative affects related to SRL and these anticipations may support maladaptive cognitions, which are emotions and behaviour leading to underachievement, (e.g. poor performance on an exam).

2.1.3 Regulation of behaviour

Pintrich's (2000a) framework contains behavioural regulation activities such as time and effort planning including making study schedules and allocating time for different activities. Several resource management strategies can be used to control behaviour in activities of academic learning, such as time management, effort regulation and persistency, and peer learning and help-seeking. In this study, the strategies used for regulation of behaviour are time management, self-management, persistency, help-seeking and peer learning, and self-assessment of learning.

The resource management strategies are cognitive and metacognitive in nature, but Pintrich and McKeachie (2000) mention that they clearly differ from both. Time management may be the most studied management strategy and one of the most necessary for successful studying. Time management includes monthly and weekly scheduling and managing time during the studying spell to use hours efficiently. Self-management, in terms of effort end persistence as well as time management, is directly related to learners' motivational patterns. Effort regulation is among the most important components of SRL. A learner should know when to increase effort and persist on a task, as well as when maximal effort is not required for success.

Help-seeking in Pintrich's (2000a) model involves a learner's own behaviour, but also contextual control, as it involves seeking help from others. Ryan and Pintrich (1997) consider help-seeking as social interaction, and as such it demonstrates the importance of considering the social nature of learning (Pintrich, 2004). In this study, help-seeking strategies are considered regulation of behaviour.

2.2 Development of SRL research

Pintrich developed his SRL model at the end of a time period (1980s–1990s), which Schunk and Greene (2018) characterise as a period of development in self-regulation research in education. During that period the SRL research emphasised the relation of self-regulation to outcomes such as achievement beliefs, affects and behaviours (Schunk & Greene, 2018). Self-reporting instruments were widely used in this time-period, and a commonly used instrument was the MSLQ (Pintrich, Smith, Garcia, & McKeachie, 1991; 1993). Even though, many of the widely used SRL theories were initially developed during these years (e.g. Zimmerman's (2000) Cyclical Phases Model; Boekaerts' SRL models, (1991, 1992, 1996); Winne and Hadwin's (1998) model), theoretical discussions and reflections on SRL models have continued since then (e.g. Efklides, 2011; Hadwin, Järvelä & Miller, 2011).

The second period of SRL research continued into the 2000s. Schunk and Greene (2018) describe this period as one of intervention research. The research of this era captured some of the dynamic nature of SRL, but it was still rare to

investigate learners adapting their approaches while engaged in learning tasks, which would better reflect SRL as a continuous, dynamic process (Schunk & Greene, 2018). Furthermore, Schunk and Greene (2018) identified a third period of SRL research, namely, the period of operation, which is still ongoing. The general research model of this period involves a reciprocal relation between self-regulation and achievement outcomes. According to Schunk and Greene (2018), in order to capture both the dynamic and cyclical natures of SRL, different methodologies are being increasingly employed in this research model, such as think-aloud protocols, observations, traces and microanalytic methods. For example, Winne, Hadwin and Gress (2010) have used Winne and Hadwin's theoretical model from 1998 to develop computer-supported learning environments (nStudy and gStudy), which record students' activities for trace and log data and simultaneously offer scaffolding for students' SRL. In general, more online and real-time methods have been developed for data collection in SRL research in addition to off-line methods, such as self-reporting questionnaires, which were formerly more common (Panadero, 2017; Winne & Perry, 2000).

In recent years, research related to the social aspects of SRL has increased considerably (Hadwin, Järvelä, & Miller, 2011). Theoretically Hadwin et al. (2011) place the term social as a central for regulated learning, which is seen as influenced by socio-cultural context, appropriated through participation or situated in social activity systems. Self-regulated learners have social interactions with their learning contexts, other learners, and as a strategy the learner may also actively seek help from peers or others more capable. According to Boekaerts (2011), numerous researchers have observed that in the initial stage of a learning process, learners need a teacher or a more advanced peer to help with the regulation of several aspects of the learning process. In addition, learning settings are nowadays more often collaborative than individual, and thus regulation within group activities is becoming more relevant. Panadero and Järvelä (2015) distinguish two different levels of regulation in collaborative learning situations. In unbalanced co-regulation of learning (CoR), one or more group members regulate other members' activities towards a 'group goal' (Hadwin et al., 2011). In a more balanced approach to collaboratively regulated learning learners regulate the learning of the group, which is commonly known as socially shared regulation of learning (SSRL) (Panadero & Järvelä, 2015).

This study uses self-reporting instruments, which were widely used during the development period of SRL research, but also nowadays. This study investigates the structure of SRL in HE, which is important, even though this study does not use the most recent research methods. More understanding is still needed what are the key components in SRL and how they are related. In addition, Jackson (2018) suggested to analyse data collected by the most used self-reporting inventories to see, if there is need to re-structure the SRL inventories.

2.3 Conceptual perspectives on SRL

The concept of metacognition and the concept of SRL are used interchangeably and sometimes synonymously in educational research (Dinsmore, Alexander & Loughlin, 2008). Veenman, Van Hout-Wolters, and Afflerbach (2006) state that it is not unequivocally defined whether self-regulation is a subordinate component of metacognition or vice versa. Even though the importance of metacognition is acknowledged, the construct is not consistently conceptualized. John Flavell defined metacognition as "thinking of thinking" (Miller, Kessel & Flavell, 1970) and operationalised it into four key areas: metacognitive knowledge, metacognitive experience, goals, and the activation of strategies. Baker and Brown separated metacognition into two elements: knowledge about cognition (monitoring) and self-regulatory mechanisms (as cited in Dinsmore et al., 2008). The latter includes checking the outcome, planning, monitoring effectiveness, testing, revising, and evaluating strategies. When expanding metacognition from Flavell's original conceptualisation and including these self-regulatory metacognitive mechanisms in it, Dinsmore et al. see metacognition gradually confounded with the construct of self-regulation. However, when contemplating metacognition and self-regulation, Dinsmore et al. (2008) see the differential emphases on the role of the environment as distinctions. In self-regulation research, the environment stimulates individuals' awareness and regulatory responses, whereas in research of metacognition, the mind of an individual is the initiator or trigger for subsequent judgments or evaluations. In this study, metacognition is defined as a part of cognitive strategies in SRL. These strategies include activities related to planning, monitoring, and regulation.

In addition, SRL and Self-Directed Learning (SDL) are sometimes used synonymously. SRL was developed in the field of learning psychology and is usually described as a favourable learner characteristic, whereas Self-Directed Learning (SDL) comes from the field of adult education and pertains to both design features of learning environment and learner characteristics (Loyens, Magda, & Rikers, 2008). The SDL theory assumes that learners become increasingly self-directed as they mature and that adults are capable of planning and regulating their actions. Both theories see that learning involves active engagement and goal-directed behaviour from a learner. They both also entail task analysis, implementation of the learning plan, and self-evaluation of the learning process. Further, both SRL and SDL processes involve metacognitive awareness, and motivation is seen as a crucial component. In this study, learners are understood as key actors selecting their personal learning strategies and engaging in regulation processes, even though the learning tasks can be generated by a teacher—as accepted in SRL theories. Instead, in SDL theory, learning can be placed on a continuum, ranging from teacher-oriented at one end to self-directed at the other, but a learner is always defining the learning task by him- or herself (Loyens et al., 2008).

2.4 Individual differences in SRL

There are various previous studies showing that HE students' skills to self-regulate their learning vary fundamentally (e.g. Barnard-Brak, Lan, & Osland Paton, 2010; Peverly, Brobst, Graham, & Shaw, 2003; Vrugt & Oort, 2008). The importance of examining how effective and less effective self-regulated students differ has been pointed out by researchers (e.g. Winne, 2005).

Several researchers have investigated SRL differences by examining the kinds of SRL profiles students possess (e.g. Barnard-Brak, Lan, & Osland Paton, 2010; Dörrenbächer & Perels, 2016; Heikkilä & Lonka, 2006; and McCardle & Hadwin, 2015). To be able to calculate and analyse the profiles it is required that SRL had to be measured by several components. In the above-mentioned studies, SRL was measured in three to eleven components originating from different SRL theories. Previous research has identified SRL profiles such as competent and super self-regulators (Barnard-Brak, Lan, & Osland Paton, 2010), high or active regulators (Dörrenbächer & Perels, 2016; McCardle & Hadwin, 2015). In contrast, students who self-regulate their learning minimally or not at all have been identified (Barnard-Brak, Lan, & Osland Paton, 2010; Heikkilä & al. 2012). In addition, Dörrenbächer and Perels (2016) and McCardle and Hadwin (2015) found a group of students with a profile of moderate SRL. Also uneven or dissonant profiles with high scores on some SRL components and lower scores on other components have been identified (Barnard-Brak, Lan, & Osland Paton, 2010; Dörrenbächer & Perels, 2016).

In addition to SRL profiles, HE students' SRL has been examined according to different disciplines and gender groups. It is widely accepted that different disciplines differ in terms of instructional methods (Brew, 2008; Ylijoki, 2000), but they also differ in terms of the focus of student learning and accordingly different kind of SRL is demanded from students (Dresel et al, 2015). Researchers have claimed that academic self-regulation is context- or subject-specific and not a transferable or stable character of a learner (Anderman et al., 2001; Pintrich, 2004; Winne, 2010). This view assumes that a student is not necessarily able to regulate their learning effectively across different subjects. Even though Bong (2004) and Pintrich (2004) found evidence that self-efficacy and task value are dependent on the discipline, and Rotgans and Smith (2009) found that self-efficacy and task-value showed consistent but low-level differences between study subjects, other findings also show that SRL is not context dependent (e.g. Wolters & Pintrich, 1998).

The existing research has indicated conflicting results in SRL levels among HE students from different gender groups. In general, the results show no significant difference in the levels of the components of SRL between genders (e.g. Basol & Balgalmis, 2016; Pintrich & Zusho, 2002). However, there is evidence, that male students have higher self-efficacy in mathematics, science and computer-based

learning (Pintrich & Zusho, 2002; Venkatesh & Morris, 2000). In addition, there is evidence that female students use self-regulation strategies (Ablard & Lipschuts, 1998) and other learning strategies, such as time management, effort regulation, organisation, metacognition and rehearsal (Ruffing et al., 2015; Senler & Sungur-Vural, 2014), more often than male students. Pajares and Valiante (2001) state that gender differences in academic motivation and SRL may be a function of gender stereotypic beliefs rather than the students' gender per se. For example, female students may think they are not as capable in subjects, which male students are traditionally more interested in and committed to studying.

2.5 Academic achievement and professional competencies

Academic achievement is often understood as students' study success. The most common measurements for undergraduate HE students' success is cumulative grade point average (GPA). In addition, study success has also been measured by a student's grade received in a single course (e.g. Heikkilä & Lonka, 2006). Academic achievement may also be measured by examining study progression, that is, how many courses a student completes or how many credits they earn during certain period of time. Original Study II measured HE students' academic achievement in terms of GPA and study progression.

Academic achievement can also be understood as the achievement of certain professional competencies students need in the future. Blömeke, Gustafsson, and Shavelson (2015) studied different definitions of 'competence' and 'competency', which they argue were used inconsistently. In conclusion, they found that 'competence' ('competences' in plural) is the broader term and 'competency ('competencies' in plural) refers to the different resources of a competence. Competence describes a complex characteristic from a holistic viewpoint whereas competency includes an analytic viewpoint (Blömeke, Gustafsson, & Shavelson, 2015). Furthermore, they believe the resources of competence may be cognitive, conative, affective or motivational. In general, professional competences include a wide and heterogeneous range of competencies.

In original Study III of this doctoral thesis the achievement of professional competencies is examined in the context of teacher education. The professional competencies in Study III emphasise teacher's own activity and actions, which in the Finnish context are considered professional in contrast to the more performative role of teachers in some other contexts. In addition, the professional competencies discussed in this study are based on a wide view of teachers' professional roles in school and society as well as on the paradigms of the reflective teacher, the teacher as a researcher and inquiry-oriented teacher education (Darling-Hammond, 2005; Niemi, 2002a; 2011).

2.6 Active learning

Learners' active role is considered to be a key element in current learning theories. Drew and Mackie (2011) questioned whether the definitions of 'active learning' are robust enough to consider active learning as a theory of learning or as a pedagogical strategy. There are several definitions of 'active learning', but Drew and Mackie (2011) find that there is vagueness surrounding the concept. The core elements in active learning are student activity and engagement in the learning process. Active learning is often contrasted to a learning situation in which students passively receive information from the instructor (Prince, 2004). Watkins, Carnell and Lodge (2007, p. 71) present a comprehensive framework in which active learning is regarded as including three dimensions: behavioural, cognitive, and social. Watkins et al. (2007) argue that the behavioural element includes 'active employment and development of resources'. The cognitive dimension signifies 'active thought about experiences to make sense and so foster construction of knowledge'. The social dimension stands for 'active interaction with others on both collaborative and resource-driven basis'. Drew and Mackie (2011) reviewed publications related to active learning and suggested that a fourth dimension called affective dimension, should be added to Watkins et al.'s (2007) framework. Based on Bloom's taxonomy, Drew and Mackie (2011, p. 464) suggest that the affective dimension includes factors such as student attitudes and values, intrinsic and extrinsic motivational factors and student engagement in both individual and group contexts. Drew and Mackie (2011) claim that a learning task in active learning is approached 'mindfully', which is a concept first developed by Salomon and Globertson (1987, p. 623). Similarly, O'Grady, Mooney Simmie, and Kennedy (2013) stress that in active learning, students are cognitively, socially or emotionally engaged in learning. If a student participates in an active-learning situation without engaging in it, this is considered to be only a superficial view of active learning.

In active learning, students are engaged behaviourally through actively using and creating learning materials. The cognitive element in active learning relates to when students think 'in an active manner', construct knowledge, make decisions and make meaning from their experience. It is also crucial for students to reflect upon the experiences (Watkins et al., 2007). Moreover, in general, the descriptions of active learning stress the social elements of learning (e.g. Machemer & Crawford, 2007; Niemi 2002a, 2012; Prince 2004; Watkins et al., 2007), for example, cooperative action instead of individual work, collaborative learning instead of competing, and joint-problem-solving and sharing as tools for achieving deeper learning processes.

Researchers have widely observed that learning outcomes are positively affected by the use of active-learning methods (e.g. O'Grady, Mooney Simmie and Kennedy, 2013). In a teacher-education context, the use of active-learning

methods has proven to have several positive effects on student teachers' learning. These methods promote the acquisition of professional competencies (Kramarsky and Michalsky, 2009a) and may initiate life-long process of professional growth (Niemi, 2012; Niemi and Nevgi, 2014). The present study considers learning as active when it is based on constructivist and collaborative processes.

2.7 The importance of SRL in Higher Education

SRL plays an important role in the context of HE. Higher education, as the highest level in educational systems, prepares students for very demanding expert tasks. Researchers (e.g., Azevedo and Cromley, 2004; Bannert, Reimann & Sonnenberg, 2014; Muis et al., 2015; Vrugt & Oort, 2008) have shown that SRL processes have a central role in the managing and learning of new and complex topics, which is crucial in HE studies. Pintrich (2000a) and Zimmerman (2000a) state that students need SRL skills in autonomous learning and for coping with challenging learning situations.

According to Pintrich (2000a), HE students are expected to monitor and control their cognition, emotions, and behaviour regarding their learning goals during different phases of their studies. Park, Edmondson, and Lee (2012) found out that first-year students' development over time in SRL is the most important determinant for their ability to cope with the challenging transition to higher education. Heikkilä et al., (2012) found that those HE students with more skills to direct their learning succeed better in their studies and face fewer challenges with academic stress and exhaustion compared to their peers, who were less able to self-regulate their learning. Further, Koivuniemi, Panadero, Malmberg, and Järvelä (2017) found evidence that students with stronger skills in SRL utilise various learning strategies during learning and that for them it is easier to identify the specific cognitive challenges that affect their learning. There is also evidence that self-regulation is positively related to the deep processing, which is necessary in HE learning (Heikkilä and Lonka, 2006, Heikkilä et al., 2011, Heikkilä et al., 2012, Lindblom-Ylänne and Lonka, 1998, Lonka and Lindblom-Ylänne, 1996, Vermunt, 1998, Vermunt and Van Rijswijk, 1988). Vanthournout et al. (2012) found that lack of self-regulation is associated with non-completion of higher education studies.

HE students are expected to be autonomous and able to self-regulate their learning, however there is strong evidence (e.g. Barnard-Brak, Lan, & Osland Paton, 2010; Peverly, Brobst, Graham, & Shaw, 2003; Vrugt & Oort, 2008) that some HE students struggle to effectively self-regulate their learning. In addition, research shows that HE students' first years may be challenging before students have learned to cope with the new learning environment (Heikkilä et al., 2012; Koivuniemi et al., 2017; Nelson, Smith, & Clarke, 2012). Many HE studies require that HE students be autonomous and study independently, to be able to col-

laborate with peers, and to design and plan their own schedule for studies. Goldfinch and Hughes (2007) found out that it is the demand for autonomy that makes learning environments and tasks of HE surprisingly challenging to many young students.

Although it has been acknowledged globally that autonomy and self-regulation are needed in studies and also in working life after graduation, there are many open questions, such as what the most essential features in HE students' self-regulation are, what kinds of individual differences there are in HE students' SRL, and how SRL is related to achievement of professional competencies.

3 Research questions

The aims of this doctoral thesis are to investigate (1) how HE students' self-regulation is constructed and to determine the most essential components of SRL, (2) what kinds of differences can be found between HE students' SRL, (3) how SRL is related to academic achievement in different disciplines, and (4) how student teachers' SRL is related to active learning methods and to development of professional competencies.

This doctoral thesis aims at answering the following research questions:

1. What are the most essential components in SRL among higher education students? (Studies II, III and second order analysis)

2. How do HE students differ in their SRL?
- What kinds of SRL profiles can be identified among HE students? (Studies II-III)
- How does SRL differ between discipline and gender groups? (Study I)

3. What kind of relationships exist between HE students' SRL and academic achievement?
- How are SRL, study success, and study progress related? (Study II)
- How are SRL, active learning, and student teachers' achievement of professional competencies related? (Study III)

4 Methodology

In this section, the methodological issues of the original studies are presented. First, the context, Finnish HE, is described. Then participants, main aims, measures, and data analysis methods are presented. Finally, the research ethics are discussed. The overview of the methodological issues in the original studies is presented in Table 3, page 27.

4.1 Context of the study - Finnish Higher Education

The context of this study is Finnish higher education. Learning in Finnish universities includes much freedom and flexibility; the universities expect students to make many decisions autonomously from the very beginning of their studies. Even though the amount of independent learning varies according to the discipline, the aim of all higher education, even the most structured programs, is to educate independent academic experts. Responsibility and self-regulation of learning are demanded from students. In the Finnish higher education systems, students are required to pass very demanding entrance examinations. However, there are indications (Heikkilä & Lonka, 2006; Lonka & Lindlom-Ylänne, 1996) that even though the entrance examination for Finnish universities screens applicants and only a small percentage are accepted to most of the study programs, students passing the examination still may have varying skills for self-regulation.

Finnish HE is based on a dual model consisting of comprehensive universities and universities of applied sciences. The data for the original studies was collected during 2004-2010, in university contexts. The participants of this study were studying either for a Bachelor's degree, which can be finished in three years, or for a Master's degree, which is the second cycle university degree and can be completed in two years in full-time study.

The Finnish HE studies are not strictly structured as programs. In most disciplines, students select the courses in their major and minor subjects rather freely. They plan their own learning schedule. To make a successful study plan, students need good self-knowledge and self-regulation skills. They should be aware of their skills in acquiring information and how they use time to study effectively. Studies also often require that students combine active learning and SRL. Very often, learning in Finnish HE also demands collaborative skills and collaborative knowledge creation, because learning is based increasingly on students' active learning in small groups.

Teacher education in Finland has been provided by universities since the 1970s and the qualification is based on a combination of Bachelor's and Master's degrees, requiring five years of studies. In contrast to many other countries, teacher

education in Finnish universities requires high autonomy and SRL from student teachers. Students may create their own study plan and select modules, which qualify them for different levels of the educational system. The Finnish teacher education underlines the development of an inquiry-oriented and research-based professional culture. Teachers in Finnish schools are expected to work as independent professionals and teacher education has been developed to enhance this role. The competencies demanded from teachers require strong expertise in several fields and the ability to support pupils' development in SRL and in becoming agents of their own learning.

4.2 Participants and procedure

In the original studies I and II, the data saved by the IQ Learn system (Niemi, Nevgi & Virtanen, 2003) between years 2004-2008 was used. A total of 5091 student responses were gathered in several Finnish universities but owing to missing data on one or more sub-scales or the background information, some of the responses were neglected. The final sample consisted of 1248 students who came from eight universities in Southern Finland, representing different disciplines such as Economic Science, Technology and Architecture, Behavioural Sciences, Bioscience and Medicine, Science, and Arts. Most of the participants had filled in the IQ Learn inventory during their first year of studies. Furthermore, in Study II the data for examining students' study achievements was gathered retrospectively from the university's student register in June 2010. This data included study credits and additional demographic background variables for a total of 229 undergraduate students.

The data for the original study III was collected in 2010 through a web-based survey. The participants were 422 students from class teacher and subject teacher programs in two Finnish universities providing similarly structured, high quality teacher education. Both universities have been actively involved in national cooperation to develop teacher education and follow joint agreed recommendations (Niemi, 2011). Around 30-42% of all student teacher groups responded to the questionnaires. Unlike the other two original studies, participants in this study were provided with several different questionnaires, from which responses to three questionnaires were used in Study III.

4.3 Instruments

In the following chapters the three self-reporting instruments applied for the data collection of the original studies are described.

4.3.1 Self-Regulated Learning Instrument

Pintrich and his colleagues (Pintrich, Smith, Garcia & McKeachie, 1991; 1993) created the Motivated Strategies for Learning Questionnaire (MSLQ) for measuring SRL (see Table 2). Pintrich (2004) has underlined that the MSLQ does not assess all components of his SRL framework, as the instrument was developed several years before his comprehensive SRL model. However, according to Roth, Ogrin & Schmitz (2016), the MSLQ is the most used instrument in SRL measurement. Honicke and Broadbent (2016) also claim it is the most used instrument in self-efficacy measurements. The strength of the MSLQ is that it combines SRL and motivation and thus offers detailed information about students' use of learning strategies.

The self-report instrument used for measuring self-regulated learning in this doctoral thesis was originally based on the MSLQ (Pintrich et al., 1993). The MSLQ instrument was further developed by Pekka Ruohotie and his research team for Finnish vocational education and for adult learners in several research projects, yielding to three adaptations of the MSLQ (Ruohotie, 1994; 1998). The third version of the instrument, labelled as Abilities for Professional Learning (APLQ) (Ruohotie, 2000b), retained the same basic structure as the MSLQ, measuring both motivational factors and learning strategies (Nokelainen & Ruohotie, 2002). The IQ Form research group developed the APLQ further for the Finnish Virtual University through validation processes (Nevgi, 2001; 2002) to measure HE students' self-regulated learning (Nevgi, 2002; Niemi, 2002b; Niemi, Nevgi & Virtanen, 2003). The components of the original MSLQ and the IQ Learn inventory are presented in Table 2. The IQ Learn inventory consists of three scales: Motivational and Affective Factors in Learning (c.f. Pintrich's Motivational Components of Forethought), Regulation Strategies, and Learning Strategies (c.f. Pintrich's Cognitive Strategies and Learning Skills) (Pintrich 1995; 2000b; Pintrich & Garcia 1991). The scale Motivational and Affective Factors in Learning include components regulating motivation and affect. The scale Regulation Strategies is composed of regulation of behaviour and the scale Learning strategies include components related to regulation of cognition. The component self-assessment in IQ Learn inventory includes two aspects, metacognitive monitoring and self-evaluation of behaviour, and therefore it is included in both the cognitive and behavioural areas of regulation in Table 2. All three scales of the IQ Learn instrument were applied in original study II. For original studies I and III, the scores from two scales of the inventory (Motivational and Affective Factors in Learning and Regulation Strategies) were applied, even though data were collected by all three scales of the inventory.

Table 2. The SRL components in the MSLQ (Pintrich, 2004) and the IQ Learn instrument (Niemi, Nevgi & Virtanen, 2003).

	SRL components measured in the instruments			
	Areas for regulation			
INSTRU-MENT	Cognition	Motivation/affect	Behaviour	Context
MSLQ	Rehearsal Elaboration Organization Critical Thinking Metacognition	Intrinsic Goals Extrinsic Goals Task Value Control Beliefs Self-Efficacy Test Anxiety	Effort Regulation Help-Seeking Time/Study environment management	Peer Learning Time/Study environment management
IQ Learn online instru-ment	Revision Use of keywords and advance or-ganisers Finding essential Constructing knowledge Critical thinking Approaching theo-retically Self-assessment	Expectation of success Self-efficacy Intrinsic interest Task value Performance anxi-ety	Time management Self-management Persistency Help-seeking strat-egies and peer learning Self-assessment	

The reliability of the sum-scales in the IQ Learn online instrument was examined and presented in original studies II and III and they can be considered acceptable. The instrument was created to measure general SRL, not course or discipline-specific SRL. In the original studies of this research, the developed online instrument (Niemi, Nevgi & Virtanen, 2003) was used for data collection. The reliability of the IQ Learn instrument was evaluated further in a case study (Virtanen & Nevgi, manuscript), in which the self-reports collected by the IQ Learn instrument were compared to deductively analysed interviews of HE students. The results showed parallel results, even though the self-reported scores of SRL components were slightly higher than the interviews revealed, especially among the students who were less skilful in SRL according to analysis of the interviews.

The IQ Learn system was introduced to teachers of several faculties in universities and universities of applied sciences in Finland, as well as internationally. In Finland, the system has either been applied in study orientation courses or the students were encouraged to use the system independently for self-evaluation. It has also been used by teachers who wanted to add a course of learning as an addition to their regular courses. During the years 2002-2008, a total of 12,000 HE

students used the system. Finnish virtual university was disbanded in 2010, however, the IQ Learn system was utilised until 2015.

4.3.2 Active Learning Experiences Instrument

In Study III for measuring student teachers' active learning experiences an instrument validated by Hannele Niemi (2002a; 2012) was used. Niemi originally developed The Active Learning Experiences Instrument in the early 2000s (Niemi, 2002a) and later updated it slightly (Niemi, 2012; Niemi & Nevgi, 2014). The instrument includes 20 statements sharing the idea that active learning consists of independent and collaborative inquiry, structuring and restructuring knowledge, problem-solving orientation, critical approaches, and evaluations of knowledge (Niemi, 2012). In Study III, a full version of the instrument was used. The participants were asked to assess how often they had experienced active learning in their studies. In addition, for the original study III, we carried out factor analysis to see if sum-scales could be constructed out of the instrument's 20 items for further analysis. Factor analysis (Principal Axis Factoring, Varimax rotation) revealed two-factor and three-factor models. The three-factor model was selected for further analysis and three sum-variables were constructed:
A1 = Goal-oriented and intentional learning (eight items), Cronbach's alpha .89,
A2 = Autonomous and responsible group work (seven items), Cronbach's alpha .81, and
A3 = Shared and collaborative problem solving (four items), Cronbach's alpha .82.

4.3.3 Professional Competencies Instrument

The Professional Competencies Instrument consisting of 40 items was developed by Niemi (2002; 2012). In the instrument, the participants are asked to assess how well their TE programme prepared them for the teaching profession. Niemi (2012) carried out factor analysis (Principal Axis Factoring with Varimax and Promax rotations) to create a factor model for further analysis. The selected five-factor model and constructed sum variables (Niemi, 2012), based on their homogeneity, theoretical validity, and relevance, were used in Study III for further analysis. These sum variables and the Cronbach's alphas calculated in Study III were:
P1 = Designing instruction (six items), Cronbach's alpha .76,
P2 = Cooperation – teachers working with others (eight items), Cronbach's alpha .81,
P3 = Ethical commitments (seven items), Cronbach's alpha .86,
P4 = Diversity of pupils and preparing them for the future (eight items), Cronbach's alpha .86, and

P5 = Teachers' own professional learning (nine items), Cronbach's alpha .85. The items are presented in Appendix 1.

4.3.4 Measuring of academic achievement

To measure academic achievement in Study II, we analysed study success and study progression. The assessment of study success was based on the university's student register data. The study success was operationalised as the mean of all the grades (scale 0-5) weighted with the study credits earned during a student's study years.

The study progress was defined as consisting of the total number of credits earned during studies divided by the sum of terms in which a student was registered for attendance. Students at the University of Helsinki can interrupt their studies for a study term by registering as absent. For this reason, only the active study terms were calculated as an indicator of study progress, rather than using the sum of all study years. The Bachelor's degree consists of a total of 180 ECTS credits, while the Master's degree requires the completion of an additional 120 ECTS credits. Students are encouraged to plan their studies in such a way that they do not exceed the target duration of the degree programmes (3+2 years). A student progressing well should earn 30 credits per active study term.

4.4 Analysis

4.4.1 Analysis in the original studies

In Study I, internal consistency of the components of SRL inventory was examined by Cronbach's alphas. In addition, the confirmatory factor with goodness-of-fit analysis was performed to examine the factorial structure. The inter-correlations among the components of SRL were analysed by Pearson's correlation coefficient analysis. In addition, analysis of variance (ANOVA) were applied to explore the SRL differences between discipline and gender groups. To calculate the statistical significance of the differences between groups, Scheffe's post-hoc test was conducted.

In Study II, the relationships between the SRL components, study success, and study progress were investigated through correlation analysis. To analyse which motivational components predicted the use of management and learning strategies, regression analysis with forced entry method for the initial analysis were conducted. The clustering-by-cases procedure was applied to reveal the different student groups in terms of SRL. The three-cluster solution was selected, and the three clusters formed the three different SRL profiles.

The relationships between SRL, active learning, and professional competencies in Study III were examined by correlational analysis. To examine how the use of active learning methods and participants' SRL explain the achievement of professional competencies, regression analysis were conducted. A clustering-by-case procedure was used to identify the SRL profiles. The best solution comprised three clusters including student teachers with different SRL. To find out whether there were mean differences in scores of professional competencies between the SRL groups with different active learning experiences, a one-way multivariate analysis of variance (MANOVA) was conducted. The significances of the mean differences in professional competencies within these groups were analysed by one-way analysis of variance (ANOVA).

All statistical analyses for this study were conducted using statistical software SPSS's different versions for Windows.

4.4.2 Second order analysis

In addition, for this study, second-order factor analysis was calculated using the SRL data of original studies II and III. The first-order confirmatory factor analysis was conducted (Nevgi, 2001; 2002) in the validation process of the SRL instrument, which was used in the original studies. The first-order factor analysis was carried out to differentiate the SRL components which HE students use (Niemi, Nevgi & Virtanen, 2003). Based on the earlier analysis, the sum-scales for the IQ Learn inventory were calculated, and three scales for the inventory were created. In this summary part of the doctoral thesis, the aim of the second-order factor analysis was to find how HE students' SRL components (i.e. the sum-scales) are related to each other. Other aims for conducting the second-order factor analysis were to find latent relations between the SRL components and to investigate whether bigger SRL components could be identified. For the second-order factor analysis the data collected in Studies II and III by all three scales of the IQ Learn SRL inventory were used, even though the data collected by the Learning Strategies scale were not used in original study III. This choice was made because the goal of the second-order analysis was to examine SRL as multidimensionally as possible and see if any indication for SRL model's re-specification would emerge.

In addition, several studies (e.g. Jackson, 2018; Muis, Winne & Jamieson-Noel, 2007; Tock & Moxley, 2017) have documented problems with the factor structure associated with measuring SRL with the MSLQ (on which the SRL inventory used in this study is based). Pintrich (2004) stated that he further developed the conceptual SRL model (Pintrich, 2000a) more than ten years after the MSLQ was finalised in 1991, and that the MSLQ was not designed to asses all components of his theoretical SRL model. Jackson (2018) mentions that several factor-analytic studies on the MSLQ test motivation and learning strategies separately and only to first-order factor levels (e.g. Pintrich et al., 1993; Smith & Chen,

2017). Jackson (2018) also states that Pintrich et al. (2000) acknowledged a lack of a strong fit between the theoretical SRL model and the empirical data, and recommended conducting more research on SRL with different populations in different contexts. For the second-order explorative factor analysis of this study, Principal Axis Factoring extraction and Promax rotation method with Kaiser Normalisation were used.

4.5 Research ethics

The quantitative data were collected with the IQ Learn online instrument in original studies I and II, and by an electronic inventory in original Study III. The IQ Learn system saved the data for participants who used the system during courses or independently. We informed the participants, either in the cover letter of the electronic inventory or when logging in to the IQ Learn online instrument, that the data would be used for research purposes following strict ethical guidelines. The system saved users' results and they could be afterwards seen by the individual students themselves and retrieved from the system for research purposes by an administrator. In addition, in original study III, the participants were informed that the data collected by several inventories would be used for research. After the demographic information of participants was coded to the data sets, all personal data was removed (email addresses and names), and only anonymous user IDs generated by the IQ Learn system or the electronic inventory software were used to individualise the responses.

When the data from the student register were retrieved for original study II in 2010, the university's instructions and ethical standards of the time were followed. At that time, it was possible to make use of information from students' study credits for research purposes without asking for students' permission, as long as the research was reported in such a manner that no student could be identified. The data were handled with special attention and anonymised as soon as it was united with the SRL data for analysis.

All the data used in different phases of this entire study was stored so that only the researchers had access to it. This study was conducted following the ethical guidelines of the National Advisory Board on Research Ethics in Finland. The principles are in line with the ethical guidelines of the European Educational Research Association (EERA) for upholding high academic and professional standards.

Table 3. Summary of methodological issues of the original studies.

	Study I	Study II	Study III	
Participants	1248 HE students from disciplines: Economic Sciences (*n* = 425) Technology and Architecture (*n* = 376), Behavioural Sciences (*n* = 153), Biosciences and Medicine (*n* = 114), Science (*n* = 113), Arts (*n* = 66)	The same participants as in Study II + data from Student register Ungraduated students (*n* = 229) from disciplines: Biosciences (*n* = 54), Education (*n* = 115), Sciences (*n* = 53), Humanities and Art (*n* = 7)	422 student teachers from Teacher Education programmes in two large Finnish universities	**Participants**
Main aims	How the 1st year university students from different disciplines and gender differ in SRL.	Correlations between motivational and affective SRL factors, regulation strategies, and learning strategies. To identify profiles in SRL. Interrelation between SRL of 1st study year and later study success.	SRL profiles of student teachers. How student teachers with different SRL profiles profit from active learning methods in achieving professional competencies.	**Main aims**
Measures	**IQ Learn instrument's SRL components:** *1. Forethought of Learning* Expectations of success, Self-efficacy, Intrinsic motivation, Utility value of studies, Performance anxiety *2. Regulation strategies* Time management, Self-management, Persistency, Help-seeking strategies, Self-assessment	**IQ Learn instrument's SRL components:** *1. Forethought of Learning* (same as in Study I) *2. Regulation strategies* (same as in Study I) *3. Learning strategies* Revision, Utilising keywords and advance organisers, Finding essential points, Constructing knowledge, Critical thinking, Approaching theoretically **Academic achievement (University's student register data):** *1. Study success* *2. Study progression*	**IQ Learn instrument's SRL components:** *1. Forethought of Learning* (same as in Study I) *2. Regulation Strategies* (same as in Study I) **Active Learning Instrument's sum-scales:** Goal oriented and intentional learning, Autonomous and responsible group work, Shared and collaborative problem solving. **The Professional Competencies** Designing instruction, Cooperation, Ethical commitments, Diversity of pupils and preparing them for the future, Teachers' own professional learning	**Measures**
Analysis	Internal consistency of SRL components, Confirmatory factor analysis, goodness-of-fit, Correlational analysis, Analysis of variance	Correlational analysis, Regression analyses, Cluster analysis	Correlational analysis, Cluster analysis, Analyses of variance (ANOVA, MANOVA), Regression analyses	**Analysis**

5 Findings and theoretical reflections

The following chapters present the findings of this study related to each research question. Directly after the results, the reflections of the findings from theoretical and previous research viewpoints are presented, related to each research question. This structure was selected in order to explore each research question on a deeper level. In the discussion, more holistic reflections will be introduced.

5.1 Defining HE students' self-regulation in learning

5.1.1 Structure and the main components of SRL

To answer the first research question concerning the relationships between several SRL components, first the constant strong relationships between specific SRL components were examined, and the question of whether these relationships increase understanding of what the most important SRL components for HE students are, was addressed.

The correlation analysis provided evidence that there are consistent features in HE students' SRL. The SRL data from Study II and Study III was used for the correlational analysis. Comparison of the correlation matrixes of the SRL data from Study II and Study III revealed consistently high Pearson correlation coefficients between the same sum-scales. As mentioned in the chapter 4.4 Analysis, the data collected by the scale Learning strategies of the SRL inventory were not analysed in Study III. However, that data were applied in the additional analysis performed for this summary part of the thesis to be able to examine SRL as multidimensional as possible. Correlation coefficients between the SRL components of the three SRL scales of data sets used in Study II and Study III are presented in Appendix 2 and Appendix 3.

Firstly, results of the Pearson correlation coefficient analysis indicated that in both sets of data there was a significant positive association between expectation of success and self-efficacy (Study II $r = .73$, $p = .01$, Study III $r = .78$, $p = .01$). In addition, self-efficacy and expectation of success showed a significant positive association with intrinsic interest. Secondly, self-management, time management, and persistency correlated strongly and positively with each other. In Study II, the values of r varied from .42 to .64 ($p = .01$) and in Study III from .41 to .64 ($p = .01$). These resource management strategies (Pintrich & McKeachie, 2000) form a basis for methodical and metacognitively active learning. If students can use these strategies effectively, they are more likely themselves the agents of their

learning. Thirdly, the Pearson correlation coefficient analysis revealed strong positive correlations between learning strategies such as approaching theoretically, critical thinking, self-assessment, and constructing knowledge. The values of *r* varied in Study I from .46 to .66 (p = .01) and in Study III from .61 to .74 (p = .01).

In order to further study the associations between the components of SRL, second order factor analysis was performed separately for the original SRL data of Study II and of Study III. The fourth resource management component, help-seeking and collaboration, was not included in the factor analysis because the correlation analysis in original studies II and III showed only non-significant or weak associations with other SRL components. Both second-order factor analysis (Principal Axis Factoring, with Rotation Method: Promax with Kaiser Normalization) yielded in the 3-factor solution. The loadings on factorial structures were rather similar. The factor loadings are presented in the Table 4.

The analysis with data from Study II provided with factors labelled as 1) *Resource management strategies*, 2) *Advanced learning strategies,* and 3) *Self-efficacy beliefs*. The analysis with data collected for Study III revealed similar factors. On the factor Resource management strategies, the components such as time management and self-management loaded highest. In addition, persistency and learning strategy, such as revision loaded highly on this factor. In the IQ Learn inventory, self-management strategy was understood as metacognitive in nature whereas time management and persistency were understood as cognitive strategies, and revision is a basic learning strategy.

On the factor labelled as Advanced learning strategies, the cognitive and metacognitive components of approaching theoretically, critical thinking, and self-assessment loaded highest. In the IQ Learn inventory, approaching theoretically describes students' application of learned theories into practice, drawing conclusions and development of their own theories, and looking for examples and applications to deepen learning. Critical thinking strategy is described as a student's ability to make critical evaluations, looking for supportive arguments, and confirming accuracy of facts. A student uses self-assessment strategy for ensuring deep understanding through questioning and discussing, for thinking over, reflecting, and explaining what s/he has learned. On this factor in Study III's data, constructing knowledge also loaded highly. This learning strategy includes activities such as utilising earlier knowledge, experiences, and information for constructing new knowledge.

On the third factor, Self-efficacy beliefs, the motivational SRL components self-efficacy and expectations of success loaded highest. These components include the three aspects that Pintrich and McKeachie (2000) describe as forming the expectancy component of SRL, such as beliefs about the ability to perform a task, judgments of self-efficacy, and expectancy for success at a learning task. The

three factors described above present the most important features for self-regulated learning in HE.

Table 4. The factorial structures of the second order factor analysis and SRL components' loadings on factors.

Sub-scales	Data from Study II, N=1248 loadings on factors			Data from Study III, N=422 loadings on factors		
	Resource management strategies	Advanced learning strategies	Self-efficacy	Resource management strategies	Advanced learning strategies	Self-efficacy
Motivational and affective components						
Self–efficacy beliefs			.821			.862
Expectations of success			.704			.725
Intrinsic interest		.305			.546	
Utility value/Task value	.465					
Performance anxiety			-.434			-.489
Regulation strategies						
Time management	.695			.804		
Self-management	.699			.684		
Persistency	.613			.540		.327
Help seeking and collaboration	r e m o v e d			r e m o v e d		
Self-assessment		.721			.811	
Learning strategies						
Revision	.710			.653		
Using keywords and advance organisers	.681			.652		
Finding essential points	.393	.320		.376		
Connecting new and old knowledge / Constructing knowledge		.482			.758	
Critical thinking		.909			.833	
Approaching theoretically		.851			.958	
	KMO = .899, df 105, p = .000 Extraction Method: Principal Axis Factoring. Rotation Method: Promax with Kaiser Normalization. Rotation converged in 6 iterations.			KMO = .863, df 105, p = .000 Extraction Method: Principal Axis Factoring. Rotation Method: Promax with Kaiser Normalization. Rotation converged in 5 iterations.		

5.1.2 Reflections on the most important components of SRL

The original studies of this research and the second-order analysis supported the structure of SRL as consisting of three basic components: Resource management strategies, Advanced learning strategies, and Self-efficacy beliefs (see figure 2). This finding is partially aligned with previous studies which measured SRL using the MSLQ. Recently, Jackson (2018) performed second- and third-order factor analysis for data collected by the MSLQ. He found four second-order latent SRL constructs, specifically, value, expectancy, strategies and resource management. The resource management construct identified in Jackson's (2018) study included sub-scales such as time and study environment management and effort regulation. In the second-order analysis of this doctoral thesis, the sub-scales time management and self-management loaded highly on the factor labelled Resource management strategies. Likewise, there were similarities between Jackson's (2018) construct of strategy use and the factor of advanced learning strategies of this study. Both included cognitive and metacognitive sub-scales, even though not all cognitive learning strategies of the IQ Learn inventory loaded on this factor in this study. Additionally, Jackson's (2018) second-order factor analysis revealed two separate constructs in the area of motivation, specifically value and expectancy. Jackson's (2018) construct of expectancy included the sub-scales control of learning beliefs and self-efficacy for learning and performance, which are corresponding constructs with the self-efficacy factor in this study, including the sub-scales of self-efficacy beliefs and expectations of success.

In addition, Jackson (2018) and Credé and Phillips (2011) found that the subscales of the MSLQ, specifically, test anxiety, peer learning, help seeking, and extrinsic goal orientation loaded weakly on the factors. This study confirms the finding of those two studies (Jackson, 2018; Credé & Phillips, 2011), as the subscale help seeking and collaboration did not correlate with the other SRL-components, performance anxiety's loading was negative and utility value loaded only weakly on the factors of this study. This finding may be due to the inventories used. Another explanation may be that anxiety, help seeking and collaboration are distinct from other measured SRL components. The SRL structure found in this study shows the importance of the three SRL components described above and brings new knowledge to understanding SRL in HE.

The models of SRL developed by several researchers (e.g. Pintrich 2000a; Zimmerman 2000a) include motivational, metacognitive, and cognitive components. In addition, there are several studies investigating the relationships between the SRL components of various SRL theories. The following will discuss how the previous studies focus on how other SRL components are related to these three basic and most important components of SRL: resource management strategies, advanced learning strategies, and self-efficacy beliefs.

Figure 2. The most important components of higher education students' self-regulated learning.

Resource management strategies

In original studies II and III, high correlations were found between time management, self-management, persistency, expectations of success, and cognitive learning strategies. Wolters and Hussain (2015) found that perseverance of effort is a strong positive predictor for all indicators of SRL, including value, self-efficacy, and use of motivational, cognitive, metacognitive, and management strategies. Students with more perseverance of effort expressed greater interest, value, and usefulness in their coursework and were more confident in their success (Wolters & Hussain, 2015). Wolters and Hussain (2015) found evidence of an association between perseverance and time management, and Wolters and Benzon (2013) found that ineffective time management was related to students' use of motivational regulation strategies. Additionally, Howell and Watson (2006) showed negative associations between difficulties in time management and the use of SRL components such as rehearsal, elaboration, planning, monitoring, and regulation.

The study of Vrugt and Oort (2008) showed that persistency was positively related to the use of metacognitive, cognitive, and resource management strategies. Students who invested more effort were more actively engaged in the process of learning and self-regulation. Vrugt and Oort (2008) demonstrated by path-analysis that among effective self-regulatory students, mastery goals had a large positive effect on metacognition, which then had an effect on the use of metacognitive, cognitive, and resource management strategies. The concept *mastery goal* relates to a learner's aims to gain new understanding and in this study, the concept *intrinsic interest* carries a similar meaning; it refers to the aim to understand and learn something for the learning itself. Both concepts contrast with *performance goals*, which relates to focus on being superior to peers.

Advanced learning strategies

As mentioned above, Honicke and Broadbent (2016) demonstrated evidence that the use of advanced learning strategies is positively related to self-efficacy. In addition, the findings of Studies II and III, which show that intrinsic interest correlates positively with the use of advanced learning strategies are in line what Bruinsma (2004) and Pintrich (2000b) found. Similarly, Vrugt and Oort (2008) found that the use of cognitive learning strategies is related to mastery goals.

Self-efficacy beliefs

Previous studies show that self-efficacy beliefs are strongly related to the use of other SRL components. Pintrich (2004), Pintrich and McKeachie (2000), and Wolters and Hussain (2015) found that self-efficacy is positively related to the active use of cognitive and metacognitive strategies, especially to the use of avanced cognitive learning strategies (Honicke & Broadbent, 2016). Brown, Peterson, and Yao (2016), Hrbácková and Hladík (2011), and Räisänen, Postareff, and Lindblom-Ylänne (2016) found that self-efficacy is positively related to the use of regulation strategies (e.g. persistency). Instead, contrary to the results of the original studies of this research, Linnenbrink and Pintrich (2003), Nelson and Ketehult (2008), and Pintrich & Zusho (2002) found positive relations between self-efficacy and help-seeking behaviour. However, in the original studies II and III, self-efficacy and help-seeking were only very weakly related.

The findings in original studies II and III that self-efficacy is negatively related to performance anxiety confirm the results of previous research (Bembenutty, 2009; Pintrich and DeGroot, 1990; Schunk, Pintrich, & Meece, 2008). Students with high self-efficacy beliefs are less likely to become overly anxious in performance situations.

5.2 Individual differences in SRL

The second research question of this study examined how HE students differ in their SRL. Various previous studies show that HE students' skills to self-regulate their learning vary from poor to excellent (e.g. Barnard-Brak, Lan, & Osland Paton, 2010; Peverly, Brobst, Graham, & Shaw, 2003; Vrugt & Oort, 2008). In this study, the differences among HE students was examined through researching what kind of different SRL profiles can be identified and how HE students' skills in SRL vary in different disciplines and between genders.

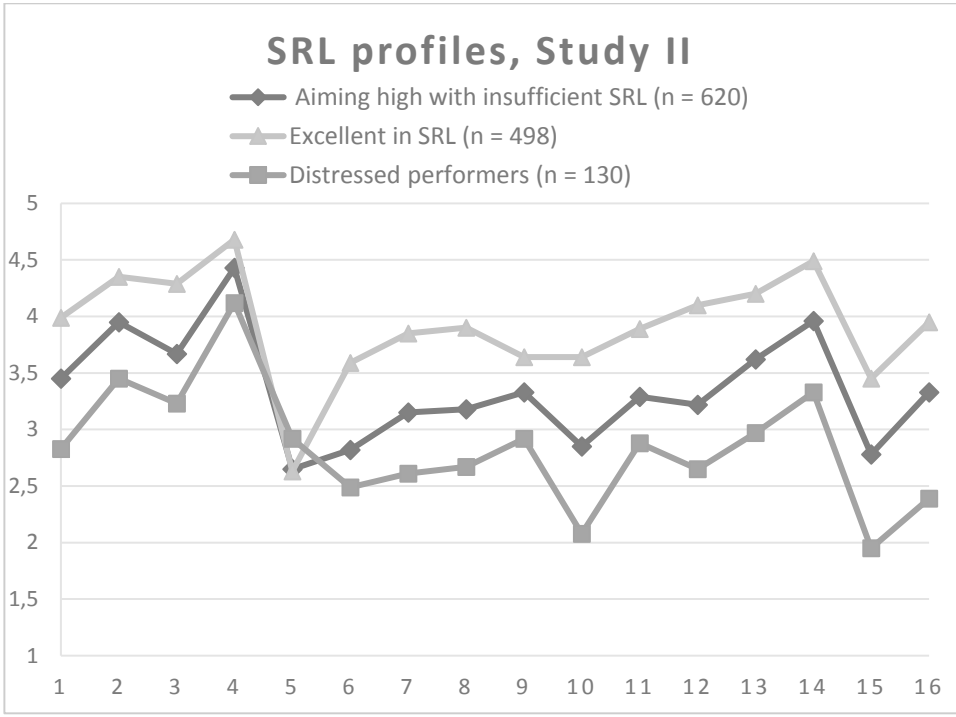
5.2.1 SRL profiles

Based on the findings of the original studies II and III of this research, different SRL profiles were identified: *Excellent in SRL* (Studies II and III), *Aiming high*

with insufficient SRL (Study II), *Dissonant in SRL* (Study III), *Distressed Performers* (Study II), and *Moderate in SRL* (Study III). In both studies (Study II and Study III), students with a profile of Excellent in SRL (see Figure 3 and 4) were highly intrinsically interested and optimistic about their success, scoring very high on self-efficacy and expectations of success. They were persistent and often used strategies to manage their learning (e.g. self-management, time management, and self-evaluation of learning). Especially based on the results of Study III, the students with excellent SRL were shown to be able to use versatile advanced cognitive learning strategies.

The students with the SRL profiles Aiming high with insufficient SRL (Study II) and Dissonant SRL (Study III) were revealed to have high self-efficacy and expectations of success. In addition, they scored high on task value and rather high on intrinsic interest. However, these students were less persistent and used less time management, self-management, and self-evaluation strategies than students with excellent SRL. In addition, students with a profile of Aiming high with insufficient SRL scored lower than students with excellent SRL in all learning strategies. Finally, for the students with the profile of dissonant SRL, it was typical to be socially oriented. They were more willing to collaborate and sought help more than the students with other SRL profiles.

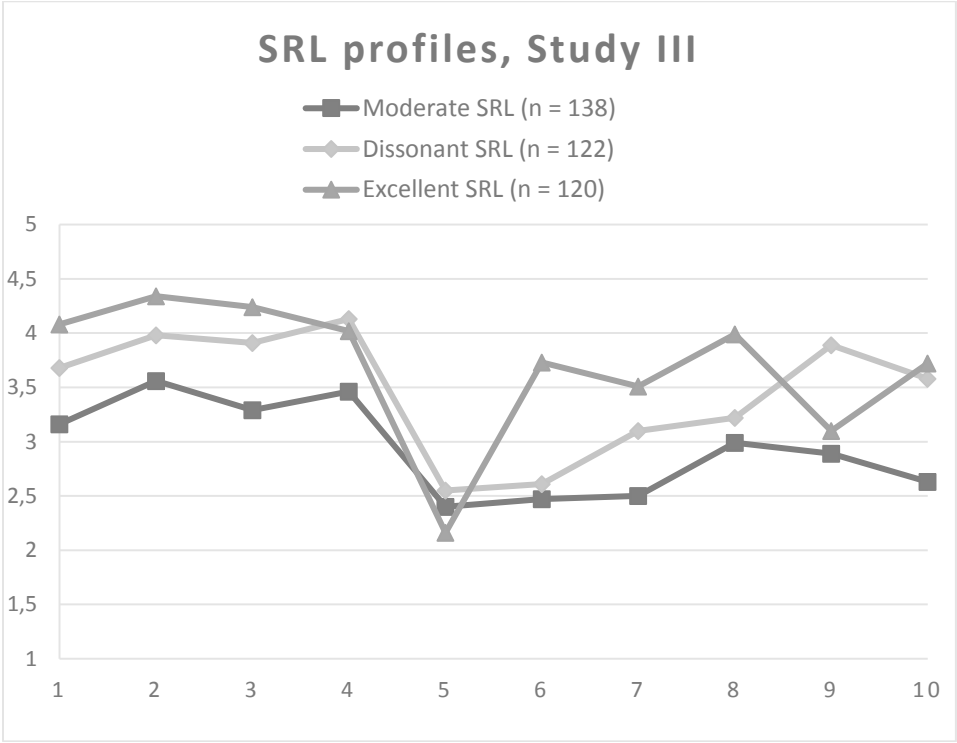
The students with the Distressed performers profile in Study II and Moderate SRL in Study III scored constantly lowest on all SRL components. However, the distressed performers showed more anxiety in performance situations than the students with other SRL profiles. Students with this profile scored moderately on motivational and regulation SRL components and all learning strategies. In addition, the low score in self-assessment revealed that students with these profiles rarely reflected upon their learning in order to improve their study strategies or self-evaluate their learning results. The participants' mean scores, profile scores in SRL, cluster centres of the cluster solutions, and significance testing of means of individual scales by clusters are shown in the corresponding original articles.



Notes: Scale 1-5, SRL components:

1. Expectation of success
2. Self–efficacy
3. Intrinsic interest
4. Utility value of studies
5. Performance anxiety
6. Time management
7. Self-management
8. Persistency
9. Help-seeking strategies
10. Self-assessment
11. Revision
12. Keywords and advance organisers
13. Finding essential points
14. Constructing knowledge
15. Critical thinking
16. Approaching theoretically

Figure 3. SRL profiles of HE students from different disciplines, Study II.



Notes: Scale 1-5, SRL components:

1. Expectation of success
2. Self–efficacy
3. Intrinsic interest
4. Utility value of studies
5. Performance anxiety
6. Time management
7. Self-management
8. Persistency
9. Help-seeking strategies
10. Self-assessment

Figure 4. SRL profiles of student teachers, Study III.

5.2.2 SRL in different disciplines and gender groups

In the original study I, it was investigated how HE students' SRL differs in different disciplines and gender groups. Researchers (Anderman et al., 2001; Bong, 2004; Pintrich, 2004; Rotgans & Smith, 2009; Winne, 2010) have claimed that academic self-regulation, as a character of a learner, is unstable and not transferable across different contexts or subjects, however the differences between the study subjects were found to be minimal. In contrast, Wolters and Pintrich (1998) showed that SRL is not context-dependent. In Study I, the SRL of HE students representing different disciplines was compared, rather than the individual students' SRL in different learning contexts.

Pintrich and Zusho's (2002) review on gender differences related to the motivational aspects of SRL showed inconclusive results, but research show diffeences between genders in the use of self-regulation strategies and learning strategies. In

Study I, we explored the differences between gender groups in motivational and regulation components of SRL.

The statistically significant differences in SRL components found in Study I are shown in Table 5. Differences between discipline groups were found in all motivational and affective SRL components and regulation strategies. In addition, differences between gender groups were found in several SRL components.

Table 5. Statistically significant differences in SRL between discipline and gender groups in Study I.

SRL sub-scales	*Discipline*	*Gender*
Motivational and affective components	*Statistically significant differences*	
Expectation of success	***	
Self-efficacy	***	
Intrinsic interest	***	*
Utility value / Task value	***	**
Performance anxiety	***	**
Regulation strategies		
Time management	***	
Self-management	***	
Persistency	***	*
Help seeking and collaboration	***	***
Self-assessment	***	
* p < 0.05, ** p < 0.01, *** p < 0.001		

In Study I, students of Behavioural Sciences, used more SRL than the students from other discipline groups. In addition, students from Science, Bioscience and Medicine, Economics, and Arts used more SRL than students from Technology, who used the least SRL in their studies.

Even though the results of the Study I showed statistically significant differences in various components of SRL, HE students' general level of SRL is not clearly dependent on discipline. However, a few systematic differences were found when the SRL results were observed using Biglan's (1973) discipline categorisation (pure/applied, soft/hard) based on cultural and epistemological differences. It was found in Study I that students of the applied sciences scored higher on self-efficacy, intrinsic interest, and utility value of studies than the students of the pure sciences. Instead, the students of pure sciences scored higher on performance anxiety. In addition, students of the applied hard sciences scored lowest on time management and self-management. The students of the soft sciences scored higher on self-assessment than the students of hard sciences, meaning they self-evaluate their learning and learning outcomes more often.

The Study I showed statistically significant differences between the disciplines within the same gender group as well. In general, female students of Behavioural Sciences had slightly higher expectations of success and self-efficacy beliefs than female students of Bioscience and Medicine. In addition, female Behavioural Science students scored higher on intrinsic interest than the students of Technology and Economics. The lowest scores in motivational SRL components were found among female students of Technology and Biosciences and Medicine, and the lowest scores in most resource management components were found among female Technology students. In regulation strategies, Behavioural Science females scored significantly higher in time management than the students of Bioscience and Medicine—and in persistency and self-assessment, higher than female students from Technology. In addition, female students of Arts and Science used statistically significantly more self-assessment than female Technology students.

Similarly, male Technology students scored lower on self-efficacy than male students from other disciplines. The male Behavioural Science students scored the highest on self-efficacy. There were statistically significant differences between male students on other motivational components as well, except on the utility value component. The Technology students scored the lowest on almost all components. In addition, the male Science students had the highest performance anxiety. There were statistically significant differences between males in regulation strategies as well: the Economics males scored higher than the Technology males on all regulation strategies.

The Study I showed that female students had slightly higher intrinsic interest than male students. It was also found that female students used statistically significantly more help-seeking strategies, valued the utility of their studies more highly, and had slightly higher performance anxiety than male students. Finally, Study I revealed that especially female students of Economics had high performance anxiety and female Technology students sought help most actively in difficulties and studied in cooperation more than male Technology students.

5.2.3 Reflections on HE students' differences in SRL

In this section, the findings concerning how HE students differ in SRL are reflected in terms of differences in SRL profiles and in terms of differences in SRL between discipline and gender groups.

Previous studies on SRL profiles have identified a group of students who are described as competent or super self-regulators (Barnard-Brak, Lan, & Osland Paton, 2010), high or active regulators (Dörrenbächer & Perels, 2016; McCardle & Hadwin, 2015), effective self-regulators (Vrugt & Oort, 2008), self-directed (Heikkilä et al., 2011), or optimistic students (Heikkilä & Lonka, 2006). Vermunt's learning pattern theory describe these kinds of students as presenting

meaning-directed learning patterns (Vermunt & Minnaert, 2003). The Excellent SRL profile in Study III resembles the above-mentioned profiles found in previous studies. For students of these profiles, it is typical to use the skills and strategies of SRL effectively, to have high motivation, a deep learning approach, and optimistic learning strategy; they focus on mastery goals and have low anxiety and less fear of failure. The previous studies and this study provide evidence that some students begin their university studies with good or excellent SRL skills, set their learning goals high, aim to succeed in their studies, are persistent, self-assess, and reflect on their learning. This result is constant despite the different theoretical conceptualisations and different research traditions used in previous studies described above.

In contrast to the strong self-regulators, different features of insufficient SRL skills have been identified in previous research depending on the conceptualisations and theoretical constructs. The Moderate SRL profile in the original Study III and the profile of Distressed performers in Study II resemble the profiles found in studies of Barnard-Brak, Lan, and Osland Paton (2010) and McCardle and Hadwin (2015), for which low SRL strategy use and motivation were typical. Further, Heikkilä and her colleagues (2012) identified a group of Non-regulating students, and Vrugt and Oort (2008) distinguished a profile of Less-effective students in SRL, which have features in common with the profiles of this study. In addition, Dörrenbächer and Perels (2016) and McCardle and Hadwin (2015) found a group of students with moderate SRL. Heikkilä and Lonka (2006) distinguished a group of reproducing students with insufficient regulatory skills, and Heikkilä et al. (2011) found a profile of Non-academic students showing low levels of SRL and hardly any critical evaluation or deep understanding. It is specific to students with all these SRL profiles that they scored either low or moderate on almost all measured components of SRL: motivational, regulation, the components measuring strategy use, and higher levels of anxiety. Additionally, Vermunt's (1998) undirected and reproduction-directed learning patterns resemble these profiles.

In addition to these constant or rather clear profiles, conflicting profiles, or profiles with qualitative peculiarities have been identified. Dörrenbächer and Perels (2016) found a profile called Conflicting SRL with high motivation where students scored high on motivational sub-scales, but low on time planning and self-evaluation, and moderate on the other sub-scales. This profile resembles the Distressed performers' profile discovered in Study II. Barnard-Brak, Lan, and Osland Paton (2010) found two profiles with variability: the Students with Forethought-endorsing self-regulating profile scored higher on goal setting and environment structuring while they scored much lower on task strategies, time management, help-seeking, and self-evaluation. This profile resembles the Dissonant SRL profile found in Study III, except that students with Dissonant SRL scored high on help-seeking and peer learning.

Between the discipline groups, the original study I showed statistically significant differences in several SRL components. However, the mean differences may be affected in the fact that students of particular disciplines are more aware of the importance of learning motivation and learning skills in general or they are more practiced in self-evaluation. Neumann (2002) described what is typical for pure hard, pure soft, applied hard, and applied soft disciplines categorised by Biglan (1973) when it comes to instructional methods, focus of student learning, and learning assessment. But perhaps the recent diversification of instruction methods in general and learner-centeredness as a principle has reduced the differences between disciplines divided in Biglan's categories. However, recent research still has evidenced disciplinary differences in relation to learning and SRL. Dresel et al. (2015) interviewed lecturers and students from different disciplines to outline the relevant learning situations in different fields demanding self-regulation from students. Dresel et al. (2015) found that exam preparation, self-study, and lecture attendance demanded different SRL in various disciplines (e.g. Economic sciences, Teacher Education, Psychology, or Engineering). However, the same SRL strategies, such as motivational regulation, management of non-social external resources, use of social resources and emotional regulation, goal setting, planning and monitoring, and cognitive deep-processing strategy were identified as the most useful strategies in all discipline fields (Dresel et al., 2015). Dresel et al. (2015) showed that the suitability of SRL strategies varies according to the specific field of study and specific learning situation. If the learning situations is not demanding students' SRL or offering possibilities to practice self-regulation, HE students' skills in SRL do not necessarily develop.

The results of the original study I showed that there were only slight differences in SRL between genders. Correspondingly, Basol and Balgalmis (2016) did not find significant differences in levels of SRL components between genders. Even though Pintrich and Zusho's (2002) review did not evidence clear differences in motivational aspects of SRL between genders, they discovered that female students generally have lower self-efficacy in Mathematics and Science. Additionally, Bao, Xiong, Hu, and Kibelloh (2013) demonstrated that male students have higher self-efficacy beliefs than females in general computer use and Venkatesh and Morris (2000) found the same gender difference in computer-based learning settings. The original Study I showed that female students scored statistically significantly higher on task value than their male peers.

The results of Study I, which show that female students use self-regulation strategies such as metacognitive skills (planning, monitoring, and evaluating) and effort management slightly more often than male students, are in line with Niemi, Nevgi and Virtanen's (2003) and Senler and Sungur-Vural's study (2014). Also, in line with the results of Study I, Ruffing, Wach, Spinath, Brünken and Karbach

(2015) provided evidence in their study that female student teachers applied learning strategies (e.g. time management, effort regulation, organisation, and metacognition) more than their male counterparts.

If viewed from a person-centred approach, the results of Study I show that individual differences in SRL exist. It is worth considering whether HE students with different SRL be guided differently to enhance their learning. In addition, it is worth studying how students with different SRL profiles benefit from the learning settings demanding or supporting SRL (e.g. active learning). There are very few studies in which HE students' SRL profiles were taken into account when examining the effects of fostering SRL (Dörrenbächer & Perels, 2016), and no previous studies investigating how student teachers with different SRL profiles benefit from the use of active learning methods. However, Dörrenbächer and Perels (2016) found that HE students of the moderate SRL profile and the conflicting SRL with high motivation profile increased their self-regulation skills after SRL training. At the same time, there are results showing that only students with low SRL baseline levels could benefit from fostering SRL (e.g. Gonzalez-Pienda et al., 2014). In contrast, Dörrenbächer and Perels (2016) hypothesised that students with effective SRL skills would benefit more from an intervention or from learning methods demanding skills of autonomous and self-regulated learning, because they can more effectively control their cognitions.

5.3 Relationships between academic achievement and HE students' SRL

The third research question of this doctoral thesis concerned the relationship between HE student's SRL and academic achievement. In the following sections it is first examined how SRL, study success, and study progress are related in multidisciplinary HE contexts. Secondly, the relations between student teachers' SRL, active learning, and achievement of professional competencies necessary in teachers' work are investigated. Kramarski and Kohen (2016) and Gordon, Dembo, and Hocevar (2007) have emphasised the importance of student teachers' own SRL. Teachers who want to become effective at improving their students' self-regulation must undertake dual SRL processes themselves. They need to become proficient self-regulated learners themselves, and they must learn how to help their students to achieve personal SRL (Bembenutty 2013; Kramarski & Michalsky 2009a; 2010; Kramarski & Kohen, 2016). Several researchers (e.g. Moos & Ringdal, 2012; Perry, VandeKamp, Mercer, & Nordby, 2002) have also emphasized that teachers who have received training in self-regulated learning become more effective educators.

5.3.1 Relations between SRL, study success, and study progress

Relationship between SRL components in the first study year and academic achievement in terms of study success and accumulation of credits was investigated in the original study II. Academic achievement was explored over a long term, during the years of Master's studies of students from different disciplines. Study success was calculated as a mean of all the grades weighted with the study credits students had already earned (i.e. cumulative grade point average (GPA)). The study progress consisted of the total number of credits earned during studies divided by the sum of active study terms.

A low positive correlation (.22, $p < .05$) was found between study success and study progress, indicating that students with better grades also proceed more efficiently in their studies. However, the SRL components' correlation with study success and study progress were weak. Study II revealed surprising results, as the study progression correlated negatively with the motivational SRL components expectation of success (-.15, $p < .05$), and self-efficacy (-.15, $p < .05$). Furthermore, low negative correlations appeared between study progress and learning strategies such as critical thinking (-.13, $p < .05$) and approaching theoretically (-.13, $p < .05$).

Finally, the results of Study II did not show correlations between SRL's motivational and affective components, regulation strategies, or learning strategies and study success. This finding is contrary to Dörrenbächer and Perels (2016) and Kitsantas (2002), who found out that students with higher SRL skills showed higher learning achievements.

The result of Study II, that the study success was not straightforwardly related to the SRL components, was thought-provoking. We aimed to identify which specific components of SRL measured in the first study year are related to later success in master's level studies. In order to find out any relationship between these variables, several analyses were performed. We recoded the data into three subgroups according to the study success measured by the cumulative GPA, but the analysis of variance (ANOVA) did not show statistically significant differences between these groups' results on SRL components. In addition, the relations between SRL components and study success were examined separately for students from different disciplines, gender groups, age groups, and groups created on the basis of the amount of students' study years. However, no statistically significant correlations between these groups' study success and SRL were found. Neither did we find statistically significant differences in study success between student groups with SRL profiles such as Excellent in SRL, Aiming high with insufficient SRL, and Distressed performers, contrary to Barnard-Brak, Lan and Osland Paton's (2010) finding that students who regulate their learning minimally or have a disorganised SRL profile reach lower GPA. In addition, no statistically significant differences were found between groups created on the basis of students' level of

SRL components such as intrinsic interest, expectations of success, or performance anxiety.

5.3.2 Relations between SRL, active learning, and student teachers' achievement of professional competencies

The original study III focused on examining how SRL, use of active learning methods, and achievement of professional competencies are interrelated in Teacher Education (TE). SRL has been recognised as especially important for student teachers to be able to guide their students towards self-regulation (Vrieling, Bastiaens, & Stijnen, 2010), for student teachers' professional learning (Niemi, 2002), and different regulation skills are needed to student teachers' further professional learning (Endedijk, Brekelmans, Verloop, Sleegers, & Vermunt, 2014). However, Endedijk, Vermunt, Meijers, and Brekelmans (2014) found little evidence in their longitudinal study that student teachers become more self-regulating throughout a teacher education programme.

The main aim of Study III was to investigate whether and how student teachers with different SRL profiles profited from active learning to achieve professional competencies. To my knowledge it was the first time it was explored how excellent and less skilful SRL students achieve the competencies needed in their profession when their studies in TE include active learning methods. In this study, active learning is considered a knowledge creation process in which students have an active role. The framework of assessing active learning is based on theories that see learning as a constructivist and collaborative process (Niemi, 2011). In this study, active learning consists of independent and collaborative inquiry, structuring and restructuring of knowledge, a problem-solving orientation, a critical approach, and the evaluation of knowledge.

In recent years the use of active learning has increased in HE. The aim of active learning is to strengthen students' autonomy and ownership of their learning. Blumenfeld, Kempler, and Kracjik (2006) stated that when the ownership of learning increases, the engagement to learning increases, and as engagement is directly related to deeper learning, the learning results become better. Thus, based on Blumenfeld et al.'s (2006) statement, we assumed that active learning methods promote learning outcomes, in this case student teachers' professional competencies, which are considered here as the wide range of capabilities needed in the teaching profession in the 21st century.

The results of the Study III showed that when student teachers' experiences of active learning increased, they better achieved the professional competencies. In addition, it became evident that student teachers' high learning motivation and capability for self-regulation are beneficial for achievement of the best professional competencies. Thirdly, Study III showed that student teachers with effective SRL profited most from the active learning methods used in TE.

The regression analysis conducted in Study III showed that active learning and SRL components significantly explained achievement of professional competencies. The active learning components such as goal oriented and intentional learning were the strongest individual components explaining achievement of each of the professional competencies. Among the SRL components, task value of studies, help seeking and collaboration, and self-management were most strongly connected to the development of professional competencies. Task value was found to statistically significantly explain achievement of professional competencies such as diversity of pupils and preparing them for the future, cooperation—teachers working with others, and ethical commitments. This finding indicates that it is especially motivating for student teachers to see how in the future they can apply in their profession what they have learned in TE. Additionally, the SRL component help seeking and collaboration was found to explain the achievement of professional competencies such as ethical commitment and teachers' own professional learning. The SRL component self-management statistically significantly predicted achievement of the professional competency designing instruction. The detailed regression model summaries are presented in the original Study III.

In Study III, interesting result was found showing that student teachers with SRL profiles such as excellent, moderate, and dissonant SRL benefitted differently from the use of active learning methods. The highly motivated student teachers with excellent SRL profited substantially from the use of active learning methods. When they experienced more active learning methods, they scored significantly higher ($p = .000$) on all five professional competencies, such as designing instruction, cooperation—teachers working with others, ethical commitments, diversity of pupils and preparing them for the future, and teachers' own professional learning. Similarly, student teachers with moderate SRL profiles scored statistically higher on all professional competencies when experiences of active learning increased. The differences were significant on level ($p = .001$) on four other competencies, and on level ($p < .01$) on the competency cooperation—teachers working with others. The scores of student teachers with excellent and moderate SRL profiles developed most strongly in competencies such as teachers' own professional learning and diversity of pupils and preparing them for the future when active learning increased. Instead, student teachers with the dissonant SRL profile did not benefit as much from the use of active learning methods. However, they scored somewhat higher on professional competencies as they acquired more active learning experiences. When their active learning experiences increased, their scores were statistically significantly higher on competencies such as teachers' own professional learning, ethical commitments and cooperation—teachers working with others.

5.3.3 Reflections on the relationship between SRL and academic achievement

The previous research findings on whether SRL has a positive impact on learning results are inconsistent. Kitsantas, Winsler, and Huie (2008) and Phan (2010) found evidence that not all aspects of SRL are related to study success. In addition, several researchers: Cazan (2012), Heikkilä and Lonka (2006), Heikkilä et al. (2011), Richardson, Abraham and Bond (2012), and Sperling, Howard, Staley, and DuBois (2004), found that the correlation between study success and the aspects considered favourable for learning is low, though significant. In addition, Kosnin (2007) found a negative correlation between SRL and academic achievement.

The results of Study II are contrary to those of previous studies, which show a positive relationship between single SRL components and study success. Lynch (2006), Robbins et al. (2004), Richardson, Abraham and Bond (2012), Rotgans and Smith (2009), and Zeegers (2004) provided evidence that the motivational SRL component of self-efficacy is a strong or rather strong predictor of GPA. In addition, Senler and Sungur-Vural (2014) discovered that pre-service teachers who considered learning tasks as valuable to their professional careers received the highest GPAs. Brown, Peterson, and Yao (2016) found a small positive correlation between SRL and academic self-efficacy, but only self-efficacy had a small but positive contribution to GPA, suggesting that self-efficacy rather than self-regulation of learning was related to overall achievement. It is worth noting that Pajares (2006) found that correlations between academic self-efficacy and outcomes tend to be higher in research which measures task-specific self-efficacy.

The results of previous research examining the relations between resource management strategies and study success is also inconsistent. Contrary to the results of Study II, Richardson et al. (2012) found in a large meta-analysis of 126 studies of SRL strategies among HE students that effort regulation, time management, elaboration, and metacognition were the strategies correlating highest with GPA. Broadbent (2017), Broadbent and Poon (2015), and Senler and Sungur-Vural (2014) showed that time management was the strongest predictor of HE students' performance. Ruffing et al. (2015) evidenced small correlations between effort and academic achievement. However, Phan (2010) found no significant relation between effort and achievement and Kitsantas, Winsler, and Huie (2008) observed that time management predicted academic success only for the first- and second-year students. It can be concluded that SRL components and academic achievement measured by GPA are not necessarily positively related.

To consider why the results in Study II did not show a connection between SRL components and study success, the research setting can be observed. In Study II, we examined how SRL measured in the first study year was related to study success and study progress of later study years; it was not measured on a course

level. In contrast, the previous studies finding positive correlations between SRL components and study success measured SRL as course-specific. However, Rotgans and Smith (2009) compared the correlations between course grades and components of SRL measured by a course-specific MSLQ (Pintrich et al., 1993) and with a slightly modified general, not course-specific version of MSLQ. They found at best medium-strong correlations between components of SRL and course grades, despite the version of MSLQ. Only the course-specific measures of self-efficacy and effort regulation were more strongly related to achievement than the same components measured with the general version of MSLQ. Overall, in Rotgans and Smith's (2009) study the grade predictions based on the general MSLQ turned out to be very similar to the course-specific ones. In Study II, SRL was measured by an inventory modified from MSLQ to measure general SRL in HE. Rotgans and Smith's (2009) study showed that measuring general, not course-specific, SRL does not necessarily diminish the correlation between SRL and study success.

In Study II we explored study success in the long term, during master's degree studies. In all previous studies, where the connection between SRL components and study success was strong, study success was observed on course-level and not on Master's studies as in the original study II. Students mature and their SRL develops when they proceed in their HE studies. If SRL is measured only in the beginning of HE studies, the correlation with study success may disappear. In addition, students' SRL may vary between the courses according to their interest in contents, a teacher's teaching style, assignments, etc. Also, at different phases of studies, students may have different amounts of time to apply to learning. In young HE students' lives, many changes take place and these changes may affect the results as intervening variables. Thus, research attempting to find linear relationships between multidimensional SRL and study success will most likely not succeed.

One more explanation for not finding a correlation between SRL and study success in Study II may be that grades do not tell the truth of students' learning. Hailikari, Postareff, Tuononen, Räisänen, and Lindblom-Ylänne (2014) found that the assessment criteria that lecturers apply changes from assignment to assignment and grades change accordingly, even if the assessment criteria should be concurring, at least in the same discipline. In addition, the culture of learning and instruction and assessment methods accordingly vary in different disciplines. In the disciplines with structured instruction, teacher is regulating learning more and there is no need for students' strong SRL.

The results of original Study III showed that specific SRL components and active learning experiences explain the achievement of student teachers' professional competencies and when the experiences of active learning increased, student teachers achieved the professional competencies more easily. The results of Study III are in line with studies of Lonka and Ketonen (2012), O'Grady, Mooney

Simmie, and Kennedy (2013), and Preston, Harvie, and Wallace (2015) that found that the use of active learning methods affect the learning outcomes positively (e.g. by promoting HE students' learning motivation). Kramarski and Michalsky (2009a) showed that in teacher education context, the use of active learning methods has several positive effects on student teachers' learning. The results of the original study III showing that participants' professional development improved when active learning was used are in line with Kramarski and Michalsky's (2009a) finding that active learning promotes the acquisition of professional competencies.

The most interesting finding in Study III was that student teachers with different SRL profiles profited differently from the use of active learning in TE. The effectiveness of active learning is based on the cognitive and metacognitive processes that it initiates in students when they take responsibility of their learning and tasks. These active learning processes are also essential in SRL. Thus, it is not surprising that Study III showed that to fully benefit from active learning, students must possess effective SRL skills. It seems that a student with excellent SRL is more capable of functioning in an active learning context as a responsible member of a team, as s/he can study in a self-regulated manner in individual learning tasks. Vrieling, Bastiaens, and Stijnen (2012) found that student teachers receiving more opportunities for SRL in the educational program started using significantly more metacognitive learning strategies during one semester and they were more motivated toward learning. Active learning can be used as one method to increase student teachers' self-regulation of learning. But the results of Study III also remind us that student teachers with challenges in SRL need some teacher regulation to fully profit from active learning in TE.

6 Discussion

6.1 Main findings

The purpose of this doctoral thesis was to investigate and increase understanding on how higher education students' self-regulated learning is constructed. The second aim of this research was to find out how HE students' SRL differs and what kind of SRL profiles can be found. In addition, this study aimed to find out how HE students' SRL is related to academic achievement. Finally, the fourth aim was to examine how students with different SRL profiles benefit from active learning in teacher education and how they achieve the professional competencies. The key findings of this doctoral thesis are presented in Figure 5.

Firstly, the key findings of this study show the most important components in HE students' SRL. These components are (1) Resource management strategies, (2) Advanced learning strategies, and (3) Self-efficacy beliefs. All these components are needed for successful learning in HE. There are several well-known theoretical SRL models (e.g. Pintrich, Zimmerman) including the same SRL components found in this doctoral thesis. In addition, several research studies show the importance of these components (e.g. Jackson, 2018; Pintrich, 2000a; Linnenbrink & Pintrich, 2003).

The first important component of SRL found in this study is Resource management strategies, which is composed of time management, self-management, and persistency, including metacognitive processes. The second significant SRL component found in this doctoral thesis is Advanced cognitive learning strategies including components such as critical thinking, approaching theoretically, and self-assessment of learning. The use of the advanced cognitive strategies reflects conscious and active approaches to individual learning. Therefore, these strategies are considered important for learning in HE contexts. As Pintrich (2000a) mentions, a skilful self-regulator is able to select learning strategies to best reach one's learning goals in different learning contexts and to modify the strategies in changing contexts. Zimmerman (2000b) consider self-efficacy, the third important SRL component found in this study, as a key motivational variable in SRL, which functions in different phases of learning. Schunk and Pajares (2009) found that students with strong self-efficacy are able to maintain their motivation over time.

In addition, this study confirms the findings of various previous studies showing that the three important SRL components are positively related to each other (e.g. Honicke & Broadbent, 2016; Vrugt & Oort, 2008; Wolters & Hussain, 2015). Especially strong are the relations between self-efficacy beliefs and other SRL components (e.g. Kitsantas, Winsler & Huiel, 2008; Lynch 2006). Based on the results of this and previous studies, the significance of strong self-efficacy beliefs for HE students' learning cannot be denied.

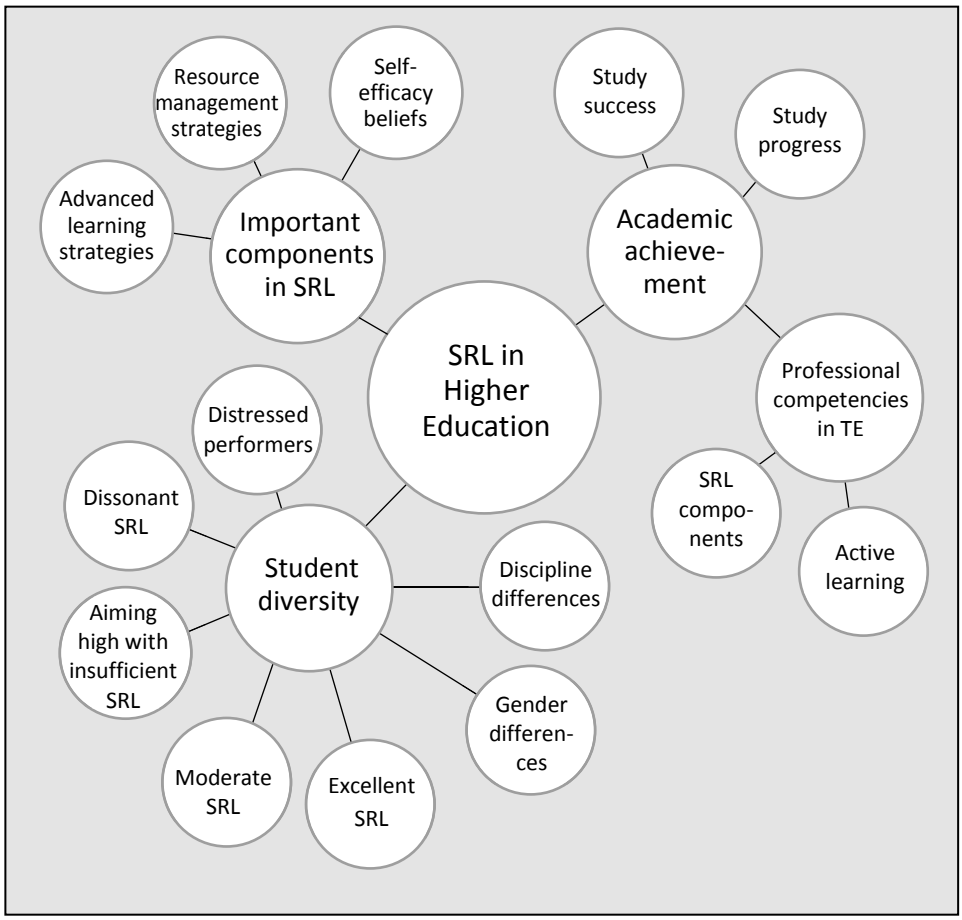


Figure 5. The key findings of this doctoral thesis.

Secondly, the original studies showed that there is diversity in HE students self-regulated learning. There are many students who begin their university studies with good SRL skills, set their learning goals high, are persistent, and keep self-evaluating their progress. There are also HE students who lack SRL skills. We found HE students who are highly motivated and have high expectations of their success but at the same time have difficulties in time management, self-management, and persistency. These students were not fully able to profit from active learning methods. These students are most likely hampered by procrastination, a dysfunction related to difficulties in time management and self-management and affecting more than half of college students (Wolters, 2003; Wolters and Hussain, 2015). In the original studies it was found out that 60 % of the HE students encountered difficulties related to time management and persistency. Procrastination is disturbing, especially in self-paced learning like writing and reading tasks

(Häfner, Oberst & Stock, 2014). In addition, procrastination has been associated with lowered academic performance and with depression, stress, and reduced sense of well-being (Schraw, Wadkins & Olafson, 2007).

This study demonstrates that there are also HE students who lack the skills of critical thinking and self-evaluation. Similarly, Heikkilä et al. (2011) found a group of students who demonstrated hardly any critical evaluation or deep understanding and showed low levels of self-regulation. However, in this study and in the study of Heikkilä et al. (2011), a similar intriguing finding was made: the study success of these students was not significantly weaker than the students with excellent skills in SRL. This finding invokes thoughts of whether it is possible to study and get a degree from university without developing advanced cognitive learning skills such as applying theoretical knowledge into practice, critical thinking, or self-reflection of learning.

In addition, a profile of distressed performers was identified in this study. Students with this profile had high performance anxiety and used the management strategies and advanced cognitive learning strategies ineffectively. Previous studies have related a lack of regulation to a surface approach of learning and task-irrelevant behaviour (Heikkilä & Lonka, 2006), fear of failure, and negative affections (Vrugt & Oort, 2008). Credé and Kunzel (2008) and Schneider and Preckel (2017) presented evidence that high test anxiety leads to significantly lowered learning outcomes in HE.

This study also revealed differences between discipline and gender groups. Especially male students of Technology used less self-regulation, and students of Behavioural Sciences used more self-regulation compared with the students from other disciplines. The students of Behavioural Sciences may be more experienced in self-reflection and use of various learning strategies. In addition, learning tasks of different disciplines may demand different skills from learners. It is also possible that some male students of Technology did not make a conscious choice of their study program, but drifted to a traditionally male discipline and lack learning motivation. This issue may be related to the concern of school-aged Finnish boys, as part of them are not interested in school tasks and do not know what to study after upper secondary school. It would be important to whet these boys' appetite for learning and support them towards self-regulated learning.

Thirdly, this study did not find a statistically significant correlation between the components of SRL, study success, and study progress among HE students from different disciplines. Likewise, several previous studies have produced inconsistent results on SRL's impact on academic achievement. The previous studies finding strong positive correlations between SRL and study success have measured study success and SRL as course-specific. In contrast, this study investigated the relation between general SRL measured in the first study year and academic achievement related to cumulative GPA, including all courses the participants had passed during several years.

This study showed that students' strong SRL skills and active learning together are effective for student teachers' achievement of professional competency. The students with the best SRL skills profited more from active learning than students with less developed SRL. Particularly, students with dissonant SRL did not fully benefit from the use of active learning in TE. In active learning settings, students should be regulating their learning strongly as the teacher functions only as a background support. If students are not capable of self-regulation, a destructive friction (Vermunt & Verloop, 1999) may take place and students' capacity for self-regulation does not develop, even though opportunities for development are provided. This shows the importance of identification of students' differences in SRL before designing learning settings, and organisation of guidance for those students in need of support. The result that active learning was beneficiary for HE students' learning encourages developing HE instruction that increases student-centeredness and students' autonomy as individuals and as collaborative learner groups. The results showed that for the best learning results, for students to become professionals of their own field and capable of life-long self-development, their SRL skills also need to be supported. In addition, the results showed that students should be offered learning tasks and larger projects where they can responsibly apply their knowledge and skills in situations related to working life, or at least situations that resemble the demands of working life.

6.2 Methodological reflections

The IQ Learn self-reporting instrument, which was used for collecting data related to student's SRL, was developed from Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich et al. (1993). It was modified based on research to be more suitable for Finnish HE students and validated after pilot use to be applied in online settings to measure general SRL (Niemi, Nevgi & Virtanen, 2003). Following the pilot study, the homogeneity of the sub-dimensions of IQ Learn inventory was improved by revising some items (Nevgi, 2002). In the original studies of this research, the validity was examined repeatedly and the IQ Learn SRL inventory was found consistent. In addition, we compared self-reports to the interviews of students and found congruent results regarding the SRL qualities among the HE students examined using these two data-collection methods.

Self-reporting has provided important information for examining and interpreting SRL (Butler, 2002; McCardle & Hadwin, 2015) because learners' own perceptions are central when the aim is to investigate SRL. Understanding self-regulated learning means understanding learners' perceptions of the ways they interpret and respond to tasks, set goals, monitor, and adapt learning in the context of the evaluations (McCardle & Hadwin, 2015). There are additional advantages of measuring SRL with self-reporting inventories. Self-reporting produces data that is easy and resource effective to code for analysis. However, besides self-reporting

questionnaires, new event-focused self-report approaches have been developed and employed to research SRL. Diaries, microanalysis, and think aloud protocols provide qualitative lenses for understanding how students regulate their learning during and across study sessions (McCardle & Hadwin, 2015). However, these methods often produce large amounts of complex data and thus are very resource intensive to code (Greene et al., 2015), contrary to self-report questionnaire-based data. The self-reporting data is effective to collect electronically, even from numerous participants, and big data analysis methods can be used. The use of big data has increased, partially because it can be applied to artificial intelligence development.

Ethical guidelines for research methodologies have been defined more carefully in recent years. In the data collection of the original studies the ethical guidelines of the time were followed. However, nowadays students' permission should be given for their study record data to be combined with other data.

Reporting the results of second-order analysis in the summary of a doctoral thesis is not a common choice to make. However, the original studies indicated that the SRL components measured were of differing importance for HE students. The second-order analysis was conducted to find out possible latent relations between the sub-scales of the SRL inventory and to find out whether larger SRL components exist in HE students SRL. For the second-order examination, exploratory factor analyses were conducted.

6.3 Educational implications

The results of this study confirmed that some HE students' development in SRL needs to be enhanced. The importance of SRL is increasing as the diversity of information sources has grown greatly; blended learning settings and MOOCs offer additional possibilities to study besides the study programs provided by one's own university. Coping with the multiple learning opportunities provided by digitalisation demands independency and responsibility from students. Thus, students need to be able to regulate their motivation and behaviour related to learning even more than they did some years ago. In addition, in the new learning contexts, there is not necessarily individual contact between students and the teacher due to the huge number of students. This gives reason for developing new methods for student guidance. Thus, intelligent technological solutions need to be developed for providing direct feedback on students' assignments and learning.

The original studies were published between 2010 and 2017. During these years Finnish HE underwent significant changes. Skills for self-regulating one's learning are even more important now than ten years ago, as the diversity in HE has increased in several ways, regarding students' backgrounds, syllabuses and learning and instruction methods. At the same time, in Finland HE teachers have become pedagogically more competent due to the greater availability of university

pedagogy courses. Teachers have developed and diversified their teaching and assessment methods, and nowadays HE students have also come to expect higher-quality instruction.

In addition to coping better in HE studies, SRL is needed in the future life. Since UNESCO'S Delors' Report (Delors, 1996), there has been discussion on how education should be developed to be able to equip the young for the future demands of life and work. Frameworks of notable international organisations have included self-regulated learning in 21st century skills (Griffin, Care, & McGaw, 2012) and SRL is included in OECD's (2018) project The Future of Education and Skills 2030, which underlines the competency of taking responsibility, creating new value and problem solving. Additionally, SRL has recently been widely discussed in educational psychology worldwide (e.g. Griffin, Care, & McGaw, 2012; NIE, 2009).

Among SRL processes, numerous researchers have underlined the central role of metacognitive monitoring processes for effective SRL (Butler and Winne 1995; Dunlosky and Thiede 2013; Fernandez & Jamet 2017; Griffin, Wiley & Salas, 2013; Winne 2011). However, this study found out the HE students lacking skills in SRL do not regularly monitor their learning. Similarly, previous research (Dunlosky and Thiede 2013; Hadwin and Webster 2013; Koriat and Bjork 2005) has evidenced that students' monitoring of their learning is often inaccurate. Dunlosky and Rawson (2012) found out that difficulties in implementing SRL processes are mainly based on inaccurate monitoring. If students are unaware of the components of SRL, it is not possible for them to monitor and develop their behaviour. To guide students towards SRL, it is crucial to provide knowledge of all the SRL components and means for self-reflection in order for them to become conscious of their own activities, motivation and cognition (Pintrich, 1995).

In Finnish HE, the students represent a more heterogeneous group in terms of age than in several other countries (e.g. in Europe). Students of different age and self-regulation skills gain from different kinds of tutoring. It became evident in the original studies that some HE students would profit from guidance and practical tips for time-management, persistency, and the use of advanced learning strategies. These management and learning strategies were strongly related to self-efficacy, which was found to be the most important separate SRL component for HE students' learning.

The varying SRL skills of HE students should be acknowledged in continuous education of teaching staff, particularly when planning university pedagogy courses. In addition, the teaching staff should be encouraged to use more active learning and other student-centred pedagogies to enhance HE students' autonomy and development in SRL. This study found out that if students find the learning tasks applicable for their future profession, they achieve the professional competencies at a higher level. In addition, the finding of the strong relation between

intrinsic interest and self-efficacy in this study shows the importance of developing learning situations that arouse HE students' genuine interest in learning. However, intrinsic interest in learning is not enough to obtain the best learning results. This study showed that when student teachers value their degree (utility value) they more easily achieve the professional competencies needed in their future work. Based on the results of this study, a suggestion to use more collaborative and active learning in HE is made. Learning actively and responsibly in student teams promotes learning in the university. In addition, in the current working environment, the ability to function as an active member in teams is a necessity for all.

6.4 Limitations of this study

The research of SRL has developed during the years that this study was realised in terms of research methodology and research areas. In addition, researchers have developed SRL as a theory. However, the fundamental understanding of SRL has remained the same, even though in recent years the research has concentrated more on processes within SRL and on developing new research instruments utilising technology. Winne and colleagues (Winne, Hadwin, & Gress, 2010; Winne & Hadwin, 2013) have developed scaffolding tools (nStudy and gStudy) that record, trace and log data, which can be used for temporal and sequential analyses of SRL. Nonetheless, learners' self-reports are still widely used in SRL research, even though researchers have questioned this method (e.g. Boekaerts & Corno, 2005; McCardle & Hadwin, 2015; Winne and Perry, 2000; Winne and Jamieson-Noel, 2002). Critique suggests that self-reporting does not capture the dynamic relations among SRL phases or processes. Winne and Jamieson-Noel (2002) argue that self-reporting creates too limited a picture of the HE students' skills in learning strategies, because students seldom report the use of the theoretically more powerful learning strategies, such as creating analogies, even when they are able to use these strategies. McCardle and Hadwin (2015) criticised self-reporting instruments tending to measure SRL as a disposition where respondents may combine their observations across time, and this provides limited information to understand how learners make strategic decisions and adapt over time. However, Tock and Moxley (2017) stated that the use of self-reporting is efficient and it has been used to predict important outcomes with measures of self-regulation (e.g. Cleary and Chen (2009); Pintrich et al. 1993).

In addition, Winne (2010) has suggested that SRL should be measured as an event instead of measuring learners' perceptions of what they generally do. Despite self-reporting instruments are criticised lacking sensitiveness to time (McCardle and Hadwin, 2015) they are criticised not always taking the context specificity of SRL into account. They argue that the use of strategies varies according to the tasks and goals. Self-reporting has also been questioned because

there is evidence (Winne & Jamieson-Noel, 2002) of inaccuracy in self-reported use of study tactics when compared to traces of the actual use of tactics. It is common for students to overestimate the use of study tactics (Boekaerts & Corno, 2005). This may be because self-reporting is dependent on students' memory and thus it may be inaccurate, based on incomplete and biased sample of experiences in a variety of different contexts. Students may also report that they use such strategies they believe are effective rather than the ones that they actually apply (Winne, Zhou & Egan, 2011). However, the SRL instrument used in the original studies of this research was not course-specific, but it measured SRL generally in HE context. This choice was made to be able to collect comparable data among students from various disciplines and stages of studies during several years.

In addition, as mentioned in the Methodology section of this study, the results of the SRL inventory were compared to the analysis of participants' interviews. The results were congruent. Similarly, McCardle and Hadwin (2015) compared the results of self-regulation questionnaires to students' weekly written diaries. Samuelstuen and Bråten (2007) measured strategic processing immediately after and in reference to a reading task, and compared the scores to physical traces of the strategies that students used during the task. The findings of these studies showed a good correspondence between the scores on the questionnaires and other data. These results show that task-specific and timely self-reporting provides reliable information on students' strategy use.

As mentioned in the Methodological reflections section, alternative analysis methods exist for the methods used in the original studies and also the second-order analysis of this study. Recently SEM has become a widely used method, and it would also have been useful in this study, especially for analysing the constructs and the important components of SRL in HE.

Additionally, in original study I, confirmatory factor analysis was conducted in order to examine the dimensionality and reliability of the scales Forethought in Learning and Learning Strategies at the scale and sub-scale levels. The fit indexes for some of the sub-scales were not satisfactory. Specifically, the RMSEA values for the sub-scales of expectations of success, self-efficacy, persistency and help-seeking strategies were slightly below satisfactory. However, the SRMR values were satisfactory for the scales and sub-scales. In future studies, SEM will make it possible to investigate causal relationships among SRL scales, as SEM simultaneously unites factor analysis and regression analysis and thus offers more flexibility than either of these two methods.

6.5 Future research

Even though extensive research has been conducted on learning in different contexts related to HE students' individual and social factors, there are still many details we do not understand clearly. Stefanou, Stolk, Prince, Chen, and Lord

(2013) assert that in particular, the relationships between student SRL and student-centred learning and how these conditions are related to different students' self-regulated behaviours, dispositions, and attitudes, need to be studied further. This study showed among other things that HE students with dissonant or moderate SRL do not profit from active learning as much as students with excellent SRL. More research is needed to understand how learning context and pedagogies may influence students' learning and how learners use self-regulated learning. This understanding could be used for creating practices and scaffolds for fostering students' development in SRL and improve learning outcomes of students with different SRL properties.

The original studies provoked thoughts that a longitudinal research setting would provide additional knowledge on SRL. A longitudinal study could reveal how HE students with different SRL develop during their university studies. This kind of study setting would also reveal how students with different SRL should be guided or tutored so that they would achieve attitudes and skills needed for independent learning and functioning in the 21st century. In addition, this research investigated the relation between SRL and academic achievement, based on a cross-sectional research design. However, the measurement of achievement in this kind of design was found to be limited. Based on these findings, in the future the research on relations between SRL and study success could also be conducted in a longitudinal research setting. Students should be followed from the beginning of studies to graduation. In addition, case studies focusing on relations between SRL and study success could bring out new insights to these relations, which previous research (e.g. Heikkilä et al., 2011; Kitsantas, Winsler & Huie, 2008; Rytkönen et al., 2012) has shown as inconsistent.

Because SRL skills are acquired through social guidance and social collaboration, and learning is based more and more on collaborative activities and learning tasks even in HE, there is a need for research combining self-regulation and socially shared regulation. Additionally, as self-regulation develops in social contexts and in collaboration with peers, teachers and family, King and McInerney (2014) claim that cultural factors are likely to play an important role in the development of self-regulation. Thus, future studies should also consider the effects of cultural perspectives on SRL and the differences in SRL among HE students with different cultural and ethnic backgrounds. Even though there are variations in how different cultures see learning and variances in the use of SRL strategies, the instruments used for measuring SRL are often based on theories that were developed in Western cultural contexts. Pillay, Purdie, and Boulton-Lewis (2000) stated that the notion of self in SRL is highly influenced by a learner's cultural environment. The self is an individual construct in some cultures, but in collectivist cultures, it also encompasses the community, where self-regulation may include the responsibility to the community that is placed on the learner (Pillay et al., 2000). Thus, it is important to take the cultural or societal traditions of the research context and

participants into account. In the same vein, there is variation in how active learning is understood. In Western societies active learning usually concerns student-driven activities and is considered essential in learner-centred learning. In some Eastern cultures, students may be *active in mind.* Even though students may actively and critically construct knowledge, this kind of active learning is not easy to distinguish by research.

It is obvious that SRL as a complex and cultural phenomenon needs to be investigated further. This research provides new knowledge to understanding self-regulation specifically in a HE context, but the continuous development of learning innovations and changing learning contexts call for new learning strategies in all educational levels. Living in a rapidly changing and digitalising world demands self-regulated learning from all of us. Besides creating opportunities for development, the changes create new needs for research.

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Appendices

Appendix 1. The sum-scales of Professional Competencies Instrument, their Cronbach's alphas and item loadings. Modified from Niemi (2012).

Professional competencies sum-scales	**α**	**Items for sum-scales**	**Factor loadings**
Designing instruction	.76	How well TE programme has prepared you for: … designing instruction? … independent management of teacher's tasks? … self-evaluating of own teaching? … using teaching methods? … mastering academic contents of curriculum? … evaluating students' learning capacity?	 .67 .53 .51 .50 .50 .34
Cooperation–teachers working with others	.81	… management of tasks outside a classroom (keep an eye on students during recess, school festivals, trips, morning assemblies etc.)? … for working in a school community (teaching staff and other school personnel)? … administrative tasks (information letters, reports, student transfers to other groups or schools, work diaries)? … cooperation with parents? … working with a student welfare group? … acting in conflict situations (e.g. mobbing)? … management of classroom interaction? … evaluating and grading of students?	.72 .63 .57 .52 .50 .48 .43 .37
Ethical commitments in teaching profession	.86	… the education of a student's whole personality? … development of own educational philosophy? … becoming aware of ethical basis of teaching profession? … life-long professional growth? … commitment to teaching profession? … supporting a learner's individual growth? … confronting changing circumstances of a school?	.61 .60 .57 .51 .50 .49 .44
Diversity of pupils and preparing them for the future	.86	… intercultural education? … confronting multiculturalism? … readiness for media education? … differentiating of teaching? … promoting equity of sexes? … preparing students for a future society? … providing readiness for students for daily life? … developing applications of modern information technology?	.74 .67 .58 .53 .53 .45 .42 .34
Teachers' own professional learning	.85	… cooperative action research? … post graduate studies in education? … researching of own work? … critical assessment of teacher education? … working as a change agent in a society? … critical reflection of own work? … self-regulated learning? … cooperation with representatives of work life? … developing of school curriculum?	.59 .58 .56 .52 .52 .44 .40 .35 .28

Appendix 2. Study II. Pearson product-moment correlations between motivational and affective components, resource management strategies, and learning strategies.

Sum-scales	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Expectation of success	-														
2 Self–efficacy	.73**	-													
3 Intrinsic interest	.48**	.43**	-												
4 Task value	.33**	.33**	.33**	-											
5 Performance anxiety	-.23**	-.29**	-.07*	-.06*	-										
6 Time management	.39**	.34**	.34**	.31**	-.08**	-									
7 Self-management	.38**	.30**	.41**	.28**	-.02	.52**	-								
8 Persistency	.48**	.42**	.45**	.32**	-.19**	.62**	.46**	-							
9 Help-seeking	.10**	.06*	.14**	.22**	.00	.12**	.25**	.15**	-						
10 Self-assessment	.42**	.36**	.51**	.18**	-.05	.34**	.52**	.40**	.19**	-					
11 Revision	.23**	.20**	.26**	.24**	-.08**	.34**	.41**	.37**	.15**	.28**	-				
12 Utilising keywords	.38**	.32**	.39**	.26**	-.06*	.40**	.52**	.44**	.23**	.42**	.45**	-			
13 Finding essential	.36**	.35**	.31**	.21**	-.13**	.37**	.46**	.34**	.15**	.44**	.29**	.56**	-		
14 Constructing knowledge	.38**	.39**	.46**	.27**	-.14**	.29**	.41**	.38**	.17**	.52**	.29**	.42**	.46**	-	
15 Critical thinking	.38**	.35**	.42**	.01	-.13**	.26**	.38**	.29**	.01	.60**	.14**	.29**	.38**	.46**	-
16 Approaching theoretically	.39**	.38**	.44**	.14**	-.13**	.30**	.42**	.33**	.11**	.64**	.23**	.36**	.43**	.54**	.66**

Notes: * Correlation is significant at 0.05 level (2-tailed) ** Correlation is significant at 0.01 level (2-tailed)

Appendix 3. Data from Study III. Pearson product-moment correlations between motivational and affective components, resource management strategies, and learning strategies.

Sum scales	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Expectation of success	-														
2 Self-efficacy	.78**														
3 Intrinsic interest	.50**	.54**													
4 Task value	.40**	.33**	.34**												
5 Performance anxiety	-.22**	-.31**	-.12*	-.07											
6 Time management	.35**	.23**	.27**	.13**	-.16**										
7 Self-management	.39**	.28**	.40**	.25**	.06	.47**									
8 Persistency	.51**	.39**	.38**	.24**	-.23**	.64**	.41**								
9 Help seeking	.02	-.05	.13**	.25**	.04	.05	.16**	.04							
10 Self-assessment	.33**	.38**	.62**	.30**	-.02	.15**	.40**	.22**	.27**						
11 Revision	.23**	.13**	.20**	.19**	.13**	.38**	.34**	.35**	.04	.13**					
12 Utilising keywords	.39**	.34**	.40**	.27**	.02	.40**	.46**	.34**	.13**	.35**	.38**				
13Finding essential	.30**	.32**	.35**	.28**	-.12*	.23**	.34**	.16**	-.04	.30**	.20**	.53**			
14 Constructing knowledge	.34**	.41**	.56**	.23**	-.07	.10	.27**	.19**	.16**	.61**	.14**	.34**	.36**		
15 Critical thinking	.34**	.40**	.54**	.17**	-.07	.09	.34**	.17**	.02	.63**	.09	.25**	.27**	.61**	
16 Approaching theoretically	.32**	.40**	.61**	.20**	-.07	.12*	.37**	.19**	.10*	.72**	.11*	.30**	.36**	.68**	.74**

Notes: * Correlation is significant at 0.05 level (2-tailed) ** Correlation is significant at 0.01 level (2-tailed)